Section 5
Delta Flood Risk

This section describes current approaches to flood management within the Delta and Suisun Marsh and the potential changes that could occur as a result of implementing the Delta Plan and the project alternatives. It describes the environmental setting, the significance of potential environmental impacts, and proposed mitigation measures. A discussion of climate change and related impacts, including sea level rise, is presented in Section 21, Climate Change and Greenhouse Gas Emissions.

The Delta Plan (the Proposed Project) does not propose implementation of any particular physical project; rather it seeks to influence, either through limited policy regulation or through recommendations, other agencies to take certain actions that will lead to achieving the dual goals of Delta ecosystem protection and water supply reliability. Those actions, if taken, could lead to physical changes in the environment. This is described in more detail in part 2.1 of Section 2A, Proposed Project and Alternatives, and in Section 2B, Introduction to Resource Sections.

5.1 Study Area

The study area for this section primarily encompasses the Delta, including Suisun Marsh. This subsection also includes integration of upstream Delta watershed reservoir and flood management improvements along the Sacramento and San Joaquin rivers, as described in Section 3, Water Resources. However, because the Delta Reform Act includes an objective inherent in the coequal goals for the management of the Delta to "reduce risks to people, property, and state interests in the Delta by effective emergency preparedness, appropriate land uses, and investments in flood protection" (Water Code section 85020(g)), this section focuses on the flood management activities within the Delta. As described in Section 2A, Proposed Project and Alternatives, it is not anticipated that changes to levee and dam facilities outside the Delta would occur with implementation of the Delta Plan or the alternatives.

5.2 Regulatory Framework

Appendix D provides an overview of the plans, policies, and regulations relating to flood management within the study area.

5.3 Environmental Setting

This section summarizes the environmental setting for levees and other/ geotechnical and flood management infrastructure and for emergency preparedness and response activities within the limits of the Delta, Suisun Marsh, and the Yolo Bypass.

5.3.1 Major Sources of Information

Information regarding levee conditions, resources, and associated issues was obtained from published sources and previous planning documents. Major sources are presented below, and a complete list of data sources is provided in Section 5.5.

- CALFED technical reports and studies
- California Department of Water Resources (DWR) reports and studies including:
  - DWR Draft FloodSAFE Strategic Plan (DWR 2008a)
  - DWR Levee Failures in Sacramento–San Joaquin River Delta (DWR 2008b)
  - DWR State Plan of Flood Control Initial Status Report (DWR 2008c)
  - DWR Phase 1 Risk Analysis Report for the Delta Risk Management Strategy (DRMS) (DWR 2008d)
  - DWR Phase 2 Delta Risk Management Strategy (DWR 2011a)
- *Battling the Inland Sea Floods, Public Policy, and the Sacramento Valley, 1850–1986* (Kelley 1998)
- *Envisioning Futures for the Sacramento–San Joaquin Delta* (PPIC 2007)
- *Navigating the Delta, Comparing Futures for the Sacramento–San Joaquin Delta* (PPIC 2008a)
- *Levee Decisions and Sustainability for the Delta, Technical Appendix B* (PPIC 2008b)
- "Discovering and Rediscovering the Fragility of Levees and Land in the Sacramento-San Joaquin Delta, 1870-1879 and Today" (Thompson 1982)
- U.S. Army Corps of Engineers (USACE) Design and Construction of Levees (USACE 2000).
- USACE Comprehensive Study, Sacramento and San Joaquin River Basins (USACE 2002a)
- USACE Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures (USACE 2009)
- USACE Geotechnical Levee Practice (USACE 2008a)
- USACE Lower San Joaquin River Feasibility Study Project Management Plan (USACE 2008b)

5.3.2 Background

Reclamation and development of the Delta began in 1848 to provide food for the communities that were established during the Gold Rush in the California foothills. In 1850, the Swamp and Overflowed Lands Act was passed by Congress, ceding federal swamplands to the states to encourage reclamation. In 1868, the State Tideland Overflow and Reclamation Act passed by the California Legislature enabled the creation of local reclamation districts, which led to the transfer of much of this public land into private ownership. Most of the original levees used to reclaim wetlands in the Delta during the mid-1800s were less than 5 feet high (Thompson 1982). These small levees initially allowed the marshlands to be drained and farmed. Later, large steam-driven clamshell dredges were used to build and enlarge the levees to increase flood protection and to combat levee and land subsidence.

In some areas of the Delta, organic peats and mucks used in this construction were not ideal levee construction materials, and seepage problems commonly developed. Organic soil material commonly shrank or compressed with placement of additional levee fill. Construction of the levees on the soft soil often resulted in irregular settlement and the creation of large cracks and fissures in levee and foundation soils. The surfaces of the reclaimed land also began subsiding as a result of oxidation of the organic soils. Levees required constant maintenance to overcome the land subsidence and settling.

Hydraulic mining in the Sierra Nevada, beginning around 1853 and lasting approximately three decades, washed vast amounts of material into the streams and canyons, resulting in reduced channel capacity downstream and increased flooding in the Sacramento Valley and the Delta. In 1893, the California Debris Commission was established to regulate hydraulic mining, planning for improved navigation, deepening channels, protecting river banks, and affording relief from flood damages. The California Debris Commission began surveys of Sacramento Valley streams in July 1905 and developed a flood management plan in 1907. The plan included constructing and enlarging levees along rivers, creating bypasses to convey flows greater than the river's capacity, and dredging the Sacramento River to Suisun Bay. The California Debris Commission had an influential role in the history of flood management, but was terminated in 1986, and all its responsibilities were reassigned to the USACE (Kelley 1998).

Use of steam-powered dredges began in the Delta in the 1870s and continued for many decades (Dutra 1980). The general approach was to dredge alluvial sediments in the sloughs and rivers and deposit the wet, unconsolidated material on the levee. After the dredged material dried out, it would be shaped into an overall levee cross section. Today, many levees in the central Delta still require periodic placement of new fill to meet specific design criteria to maintain flood protection.

The failure rate of Delta levees was generally greater in the early part of the twentieth century than during the latter half for several reasons:

- ♦ The construction of upstream storage reservoirs by the mid-1960s helped attenuate flood flows into the Delta.
- ♦ The construction of the two federal flood control projects significantly improved about a third of the levees in the Delta.
- ♦ Some of the islands that flooded in the early part of the century were not reclaimed. Consequently, this diminished the potential number of levee failures.
- ♦ The State began funding the Delta Levee Subventions and Special Projects programs in the 1980s as a result of ongoing levee failures. These grant monies helped fund levee maintenance and improvements in many areas of the Delta.
- ♦ More attention and resources have been given to flood fighting and responding to levee problems in the Delta.

In most levee failures, the breaches in the levees were repaired by either the USACE or by the local reclamation districts. Some islands were not reclaimed after flooding caused by levee failures, including:

- ♦ Western Sherman Island, approximately 5,000 acres, inundated in 1878
- ♦ Big Break, approximately 2,200 acres, inundated in 1927
- ♦ Franks Tract, approximately 3,300 acres, inundated in 1938
- ♦ Mildred Island, approximately 1,000 acres, inundated in 1983
- ♦ Little Franks Tract, approximately 330 acres, inundated circa 1983
- ♦ Little Mandeville Island, approximately 376 acres, inundated in 1986
- ♦ Liberty Island, 5,209 acres, inundated in 1998

After the floods of 1986, the USACE stated that it would no longer reclaim flooded islands that were protected by non-project levees (levees not authorized or constructed under a federal flood control project). In 2004, after the Jones Tract levee failure occurred, DWR repaired the breach and pumped out the floodwaters inundating the two tracts (DWR 1995). The total cost of island and damage recovery was nearly $90 million (DWR 2008b).

5.3.3 Current Levees

Today, approximately 1,115 miles of levees protect 700,000 acres of land within the legal limits of the Delta, and approximately 230 miles of levees protect about 50,000 acres of the Suisun Marsh. The Delta levee system carries water from the Sacramento, San Joaquin, Cosumnes, Mokelumne, and Calaveras rivers, and various creeks and streams, and transports it past the many islands and tracts within the Delta before discharging to the San Francisco Bay or being exported via water supply projects. Surface water from roughly 40 percent of California travels through the Delta each year. Delta levees protect Delta lowlands for water for agricultural, industrial, and municipal use, and are responsible for protecting multiple interests and populations.

Suisun Marsh is the largest contiguous brackish water marsh in North America, encompassing approximately 116,000 acres with managed wetlands, upland grasses, tidal wetlands, bays, and sloughs. Suisun Marsh originally consisted of a group of islands separated by sloughs with inflow from tides and floods. Large areas of the marsh are contained within levee systems and are managed as seasonal wetlands (DWR 2000, p. 4). Several facilities have been constructed by DWR and the U.S. Bureau of Reclamation (Reclamation) to provide water with lower salinity levels to the marsh’s managed wetlands. Some of the initial facilities included the Roaring River Distribution System, the Mormon Island Distribution System, and the Goodyear Slough Outfall, which were all constructed between 1979 and 1980. The Suisun Marsh Salinity Control Gates started operating in 1989 to control channel water salinity and to help meet the water quality standards established by the State Water Resources Control Board.

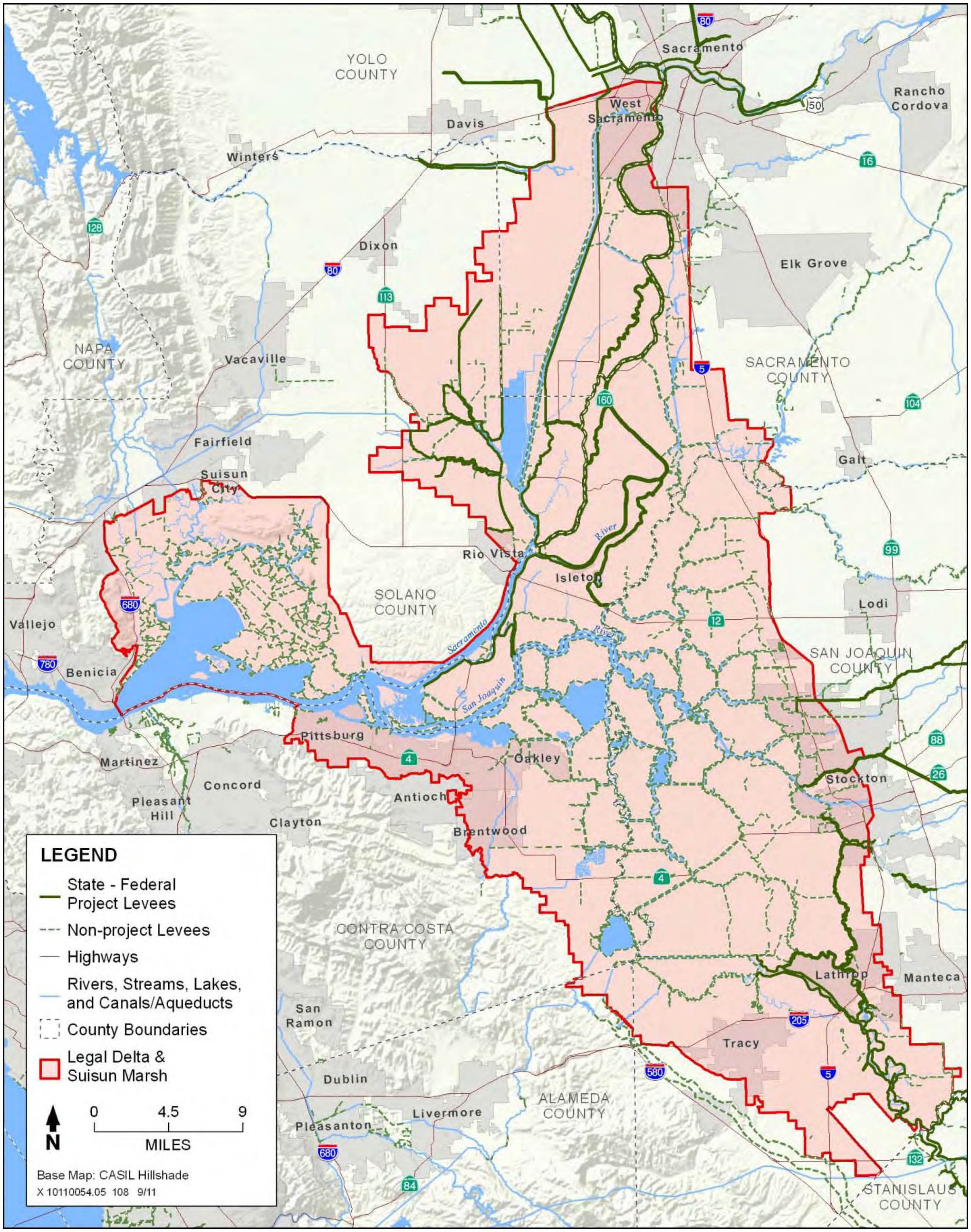
5.3.4 Overview of Flood Management Facilities in the Delta Watershed and the Delta

Upstream reservoirs, flood bypasses, and levees affect hydrology and flood management in the Delta. Nineteen major multipurpose dams reduce peak flows in the Delta tributaries as they impound runoff from winter storms and spring runoff. Many of these dams have dedicated flood control space, and they release peak flows gradually following storm events.

Two major flood management projects exist upstream of the Delta: the Sacramento River Flood Control Project, and the San Joaquin River Flood Control Project, as described below. The levees built as part of these projects are designated as “project levees” and are maintained by federal and State agencies (Figure 5-1). Approximately 1,600 miles of project levees are part of the Central Valley federal flood control projects, of which 385 miles are in the Delta. The remaining levees are designated as “non-project levees” (Figure 5-1), and are maintained by local districts, as described in Section 5.3.3. Flood flows are conveyed through the Delta and into San Francisco Bay for continued conveyance through the Golden Gate to the Pacific Ocean.

Flood management in the Delta also involves management of seepage water from Delta channels into the islands. If left unmanaged, this seepage could flood the islands. Excess seepage is pumped from the islands into the Delta channels.

Figure 5-1
Project and Non-project Levees
Source: DWR 2009



This subsection describes the following flood management facilities that are partially or totally located within the Delta:

- Sacramento River Flood Control Project
- San Joaquin River Flood Control Project
- Non-project levees in the Delta and Suisun Marsh
- Delta Drainage Facilities

5.3.4.1 Sacramento River Flood Control Project

The Sacramento River Flood Control Project extends from the Delta watershed along the Sacramento River and into the Delta and consists of the following features:

- Approximately 980 miles of levees along the Sacramento River, extending from Collinsville to Chico Landing (at River Mile 194), and the lower reaches of the major tributaries (American, Feather, Yuba, and Bear rivers), minor tributaries, and distributary sloughs in the Delta
- Moulton, Colusa, Tisdale, Fremont, and the Sacramento flood overflow weirs
- Butte Basin, Sutter, and Yolo bypasses and sloughs

Figure 5-2 shows the primary features of this project.

The principal features of the Sacramento River Flood Control Project extend from Ord Bend downstream to Collinsville, a distance of 184 river miles. These features include a comprehensive system of levees, overflow weirs, drainage pumping plants, and flood bypass channels (USACE 1992). The flood bypass channels, to a certain extent, mimic natural and historical flooding patterns. The project levees begin on the western bank just downstream of Stony Creek. Upstream of the levees, high flows on the river flow to the east into the Butte Basin, a trough created by subsidence. The Colusa Basin Drain, a similar trough located to the west of the river, intercepts runoff from westside tributaries.

Project levees were typically built on existing levees constructed for agricultural interests. The Central Valley Flood Protection Board (CVFPB) operates and maintains the project levees under an agreement with USACE (DWR 1995). Project levees in the Delta are discussed in Section 5.3.4.1.2.

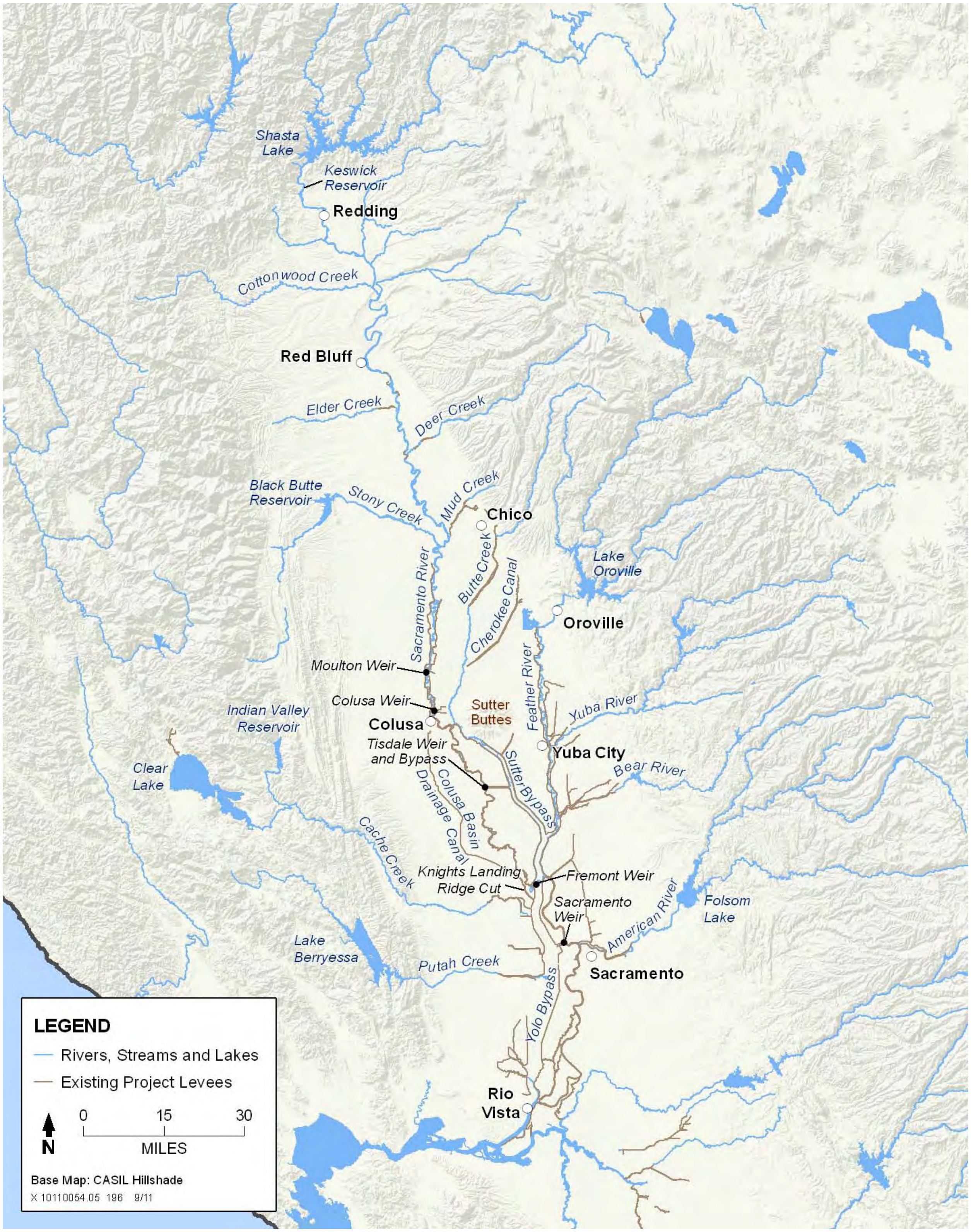
5.3.4.1.1 Yolo Bypass

The Yolo Bypass is an operative feature of the Sacramento River Flood Control Project, which was originally authorized by the Flood Control Act of 1917 and modified by various Flood Control and River and Harbor Acts in 1928, 1937, and 1941.

The Yolo Bypass is located immediately west of the metropolitan area of Sacramento and lies in a general north-to-south orientation extending from the Fremont Weir (upstream of the Delta) downstream to Liberty Island (within the Delta), a distance of about 43 miles. The Yolo Bypass encompasses about 40,000 acres and varies in width from about 7,000 feet near the Fremont Weir to about 16,000 feet at Interstate 80. Patrol roads, earthen ramps, road crossings, and turnouts have been constructed at intervals along the levees, which extend up to 20 feet in height.

During high flows in the Sacramento River, water enters the Yolo Bypass via the Fremont and Sacramento weirs. Additional flows enter from the west along tributaries, including Willow Slough, Willow Slough Bypass, and Putah Creek. Waters flows from the Yolo Bypass into the Sacramento River upstream of Rio Vista. The Yolo Bypass is flooded about once every 3 years, on average, and flood flows generally occur during the winter months of December, January, and February. Local surface waters in the Yolo Bypass flow through the Tule Canal and Toe Drain, which are west of the Sacramento Deep Water Ship Channel.

Figure 5-2
The Sacramento River Flood Control Project
Source: DWR 2008e, NHD 2010, USGS 2010



The USACE, CVFPB, and DWR are responsible for maintaining Fremont Weir, Sacramento Weir, and the flood-carrying capacity of the Yolo Bypass.

5.3.4.1.2 Sacramento River Project Levees in the Delta

Project levees in the northern Delta are primarily part of the Sacramento River Flood Control Project. The Sacramento River Flood Control Project was authorized by Congress in 1917 and was initially completed by USACE in 1960. The CVFPB, in conjunction with DWR and local reclamation districts, operates and maintains the project levees under an agreement with USACE (DWR 1995).

The Sacramento River Flood Control Project levees in the Delta include levees that protect, or partially protect, the following: West Sacramento, City of Sacramento, Walnut Grove, Courtland, Clarksburg, Ryde, Hood, lands between the Sacramento River and the Sacramento River Deep Water Channel (east levee of the Deep Water Ship Channel), Merritt Island, Sutter Island, Grand Island, Ryer Island, Tyler Island, Hastings Tract, Prospect Island, Brannan Island, Twitchell Island, Pierson Tract, and Sherman Island (DWR 1993).

The USACE and State and local agencies have regularly rehabilitated bank erosion along project levees under the authority of the Sacramento River Bank Protection Project. The Sacramento River Bank Protection Project addresses long-term erosion protection along the Sacramento River and its tributaries. Historically, within the Sacramento area, bank protection measures typically consist of large angular rock placed to protect the bank and then a layer of soil/rock material is placed to allow vegetation to grow back on the bank. Recently, USACE modified the policy to not allow vegetation on the waterside of the levee. In some areas, dead trees may be placed along the waterside of the levee above the flood elevation to improve habitat value. Annual rehabilitation efforts provide bank protection to prevent further erosion into the waterside slope of the levee that may be threatened with failure by erosion. Each year USACE conducts an inventory of erosion sites and prioritizes those that are most critical. As of December 2008, there were 58 identified erosion sites in the Delta (USACE 2008b).

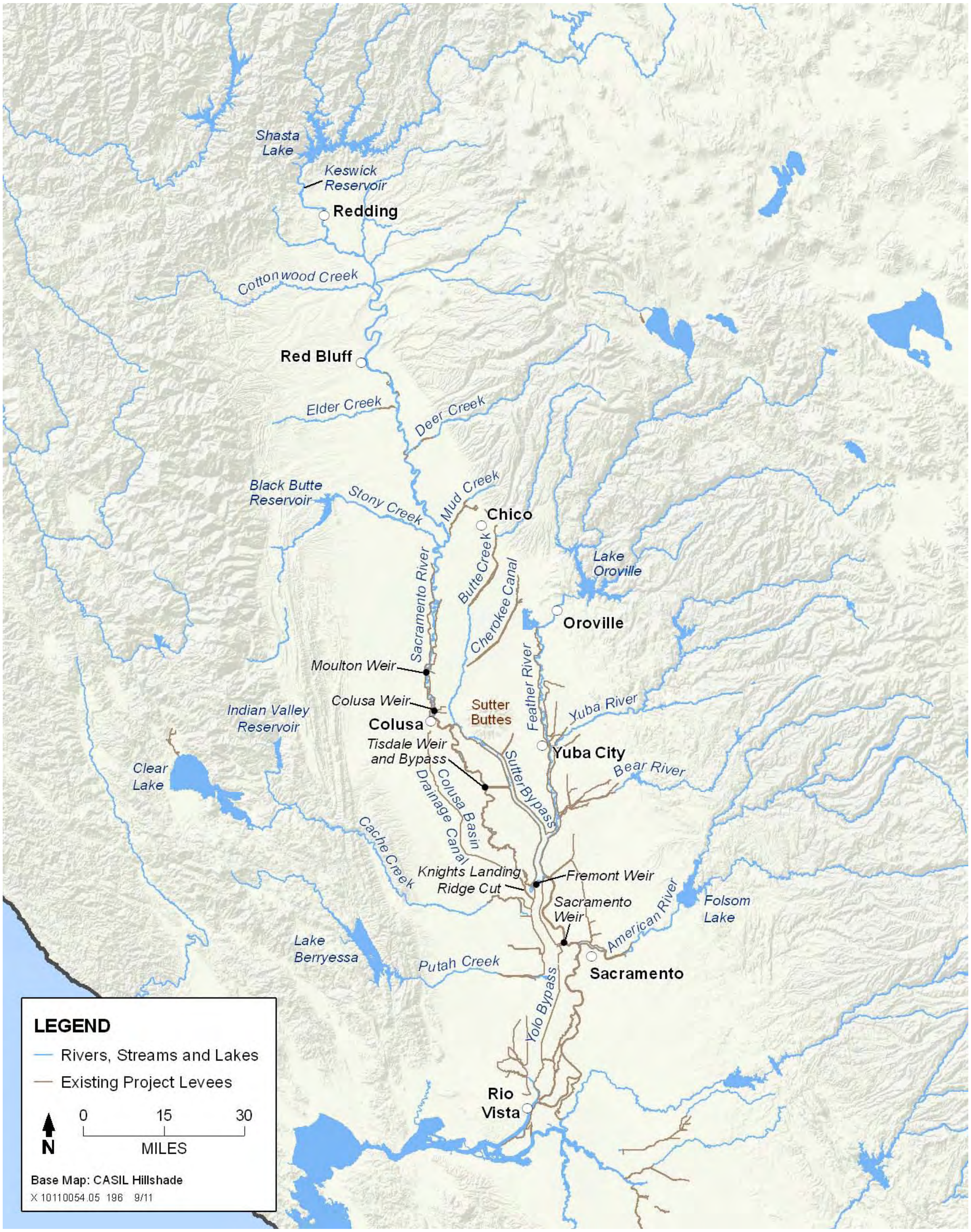
5.3.4.2 San Joaquin River Flood Control Project

The San Joaquin River Flood Control System, or Project, extends from the Delta watershed along the San Joaquin River into the Delta and consists of the following features:

- Approximately 600 miles of levees in several federally authorized flood control projects extending from Stockton to the upper San Joaquin River watershed and floodways on most rivers that flow into the San Joaquin Valley and Tulare Lake Basin
- Friant Dam near Fresno, Buchanan and Hidden Dams on the Chowchilla and Fresno rivers, New Exchequer Dam on Merced River, Terminus Dam on St. Johns River, and project levees on Ash Creek, Berenda Slough, Mormon Slough, and Fresno River
- Lower San Joaquin River Control Project includes levees on the San Joaquin River downstream of the Merced River; levees on the Stanislaus River, Old River, Paradise Cut, and French Camp Slough; and New Hogan Dam on Calaveras River, New Melones Dam on Stanislaus River, and New Don Pedro Dam on Tuolumne River
- The Chowchilla Canal, Eastside, and Mariposa bypasses

Figure 5-3 shows the primary features of this project.

Figure 5-3
The San Joaquin River Flood Control Project
Source: DWR 2008e, NHD 2010, USGS 2010



5.3.4.2.1 Lower San Joaquin River Project in the Delta

The Lower San Joaquin River Flood Control Project was authorized by Congress in 1944 and includes levees that protect, or partially protect, Stockton, Lathrop, Manteca, Tracy, Stewart Tract, Upper Roberts Island, Middle Roberts Island, Lower Roberts Island, Pescadero District, and Union Island (USACE 2008a, 1999).

5.3.4.3 Non-project Levees in the Delta and Suisun Marsh

Most of the levees in the Delta are non-project levees, comprising 730 miles out of 1,115 miles (see Figure 5-1). In Suisun Marsh, all of the approximately 230 miles of the levees are non-project levees. These levees are not part of the federal flood control program and are maintained by local agencies, reclamation districts (regulated by CVFPB and not affiliated with Reclamation), levee maintenance districts, and landowners. Some of the maintenance activities are partially reimbursed by DWR under the Delta Levee Subventions Program established in 1973. The Delta Flood Protection Act of 1988 significantly increased reimbursement opportunities and added mitigation requirements to ensure no net long-term loss of habitat. Improvement and maintenance of these levees are challenging because many require frequent maintenance by local agencies and groups that have limited funds to both maintain the levees and protect levee wildlife habitat (DWR 1995).

Two recently initiated non-project flood protection facilities in the Delta include a system of levees and sloughs to protect Stockton, and a large ring levee to protect Stewart Tract, site of the future River Islands development. The Flood Protection Restoration Project to protect Stockton is managed by the San Joaquin Area Flood Control Agency and intended to meet Federal Emergency Management Agency (FEMA) standards to keep urban areas outside the regulatory floodplain. The Flood Protection Restoration Project consist of floodwalls and levee improvements, 12 miles of new levees, modifications to bridges, and two new detention basins.

A large ring levee is planned for Stewart Tract, an island about 5 miles long in the southern Delta. This ring levee is designed to protect the planned urban development from a 200-year flood. The ring levee would be 300 feet wide with broad side slopes. Portions of the ring levee have been constructed by the River Islands developer.

The Delta supports two major inland ports, one in Stockton and one in Sacramento, served by deep water channels. The Stockton Deep Water Ship Channel was built in 1933 and follows the San Joaquin River past Rough and Ready Island to the Port of Stockton via Stockton Channel. Levees along the San Joaquin River and Stockton Channel are non-project levees. The Sacramento River Deep Water Ship Channel follows the Sacramento River and Cache Slough prior to entering the excavated deep water channel that extends to the Port of Sacramento in West Sacramento. The levees on the east sides of the Sacramento River, Cache Slough, and the Sacramento River Deep Water Ship Channel are project levees. The levees on the west side of the Sacramento River upstream of Rio Vista, west side of Cache Slough, and a portion of the west side of the excavated channel near Cache Slough are non-project levees.

5.3.4.4 Delta Drainage Facilities

Numerous facilities throughout the Delta drain rainfall runoff from land into Delta channels. Local cities and districts own and maintain urban storm drains in developed areas. Stockton, Sacramento, West Sacramento, and Tracy are the larger cities in the Delta with storm drainage facilities. Most islands in the Delta have a network of agricultural drains and pumps to pump runoff into the Delta channels.

Additional drainage issues arise from levees through seepage and underseepage. When water ponds against a levee, it seeps into and through the levee embankment. Over time, the seepage can penetrate the levee section and exit on the landside, which adds to the water to be drained from the island. Similarly, underseepage, caused by ponding water against a levee that seeps into the foundation soil and exits on the other side of the levee, can add to the drainage issue.

Because Delta islands are near or below sea level and surrounded by levees, they depend on interior drainage and pumping for the ground surface to stay dry. Interior drainage consists of ditches, canals, and pipes that convey water to pump stations, where it is pumped over the levees and into Delta channels. Island interior drainage infrastructure was built typically to drain agricultural runoff. In the event of a levee breach, additional pump capacity would be needed to pump out floodwaters and reclaim the island to prevent further property damage and public health problems caused by prolonged inundation.

In response to the 1997 flood, the Pump Out Program was implemented by DWR (DWR 1997a). The main objectives of this accelerated floodwater Pump Out Program were to protect land and property from damage caused by prolonged flooding, safeguard public health and safety, and alleviate economic and environmental problems. The Pump Out Program operated through local counties and reclamation districts. DWR reimbursed local agencies for pumping costs and received reimbursement from the federal government.

5.3.5 Present Risks

Because risks change over time, the present (as defined DWR in the recent DRMS project, which selected a base year of 2005) is used in this EIR for beginning a discussion of risks.

In the Delta, risks have changed over time and are still changing. In the early 1900s, the levees were quite low, and the "islands" were more like real islands with ground surface elevations approximately the same as the adjacent river water surface elevation except during floods. Over the past 100 years, subsidence has created a pronounced "bowl" effect and the levees have been raised with some levees 15 to 25 feet tall. Because the costs of land, improvements, and recovery have increased, the consequences of failure are also larger for the land uses and residents within the islands. Californians also rely more on the Delta for conveyance of water supply, and the Delta ecosystem is becoming increasingly fragile. Therefore, the consequences of levee failure are not limited to the islands that are inundated but also could affect adjacent ecosystem habitats, communities, and water users located outside of the Delta that use Delta water.

Several major studies have looked at various types of risks related to Delta levees:

- Seismicity Hazards in the Sacramento-San Joaquin Delta (DWR 1980)
- The Sacramento-San Joaquin Delta Investigation Documentation Report (USACE 1982)
- The Delta Levees Investigation, Bulletin 192-82 (DWR 1982)
- Seismic Stability of Delta Levees (DWR 1992)
- *Seismic Vulnerability of the Sacramento-San Joaquin Delta Levees* (CALFED 2000)
- The Delta Risk Management Strategy (DRMS), Executive Summary, Phase 1 (DWR 2008d)
- DWR DRMS Phase 2 (DWR 2011a)

All have come to similar conclusions. Some Delta levees face unusually high risks because they are situated on poor foundations and were built prior to the development of modern design and construction procedures, especially regarding compaction and seismic stability. The stresses on some levees have also increased over time as the landward ground surfaces subsided and the heights of the levees correspondingly increased.

The available information on the various risks from multiple sources is summarized in the following sections.

5.3.5.1 Flood Risks

Levee failure can occur through levee breaches, seepage and under seepage, and excessive water pressure on the levees. Breaching of the levee (overtopping) is the most common type of mechanism that could lead to levee failure. The breach potentially promotes crown and landside slope erosion, which could degrade the levee such that a massive levee failure occurs. When the levee is not overtopped, but the water elevations (also known as "stage levels") are elevated, seepage and underseepage are also mechanisms that could lead to levee failure. Excessive seepage potentially leads to creation of holes in the levee (also known as "piping," or internal erosion) and boils on the island side of the levee (the erosion exit point near the landside toe). The piping and/or boils could cause removal of large volumes of levee embankment or foundation material such that massive levee failure occurs. An additional failure mechanism during high stage is the buildup of excessive water pressures in the levee, which could lead to slope instability and ultimately levee failure.

FEMA and DWR have developed analytical procedures to define the probability of flooding and assess the risk of levee failures caused by flooding.

5.3.5.1.1 FEMA Analyses

FEMA is a primary source of present flood risk information. A key element of the program uses Flood Insurance Studies to produce Flood Insurance Rate Maps (FIRMs).

Risk of flooding is defined by the probability that a flood will occur in any given year. For example, the "100-year flood" is a flood that has a 1 percent chance of occurring in any given year. This is also referred to by FEMA as a 1 percent annual chance of flooding. Likewise, the "200-year flood" and "500-year flood" are floods that have a 0.5 percent and 0.2 percent chance, respectively, of occurring in any given year.

The FEMA flood map database is used to help establish the level of flood risk that exists at each community. FEMA's floodplains are delineated as follows:

- Special Flood Hazard Areas (SFHA): Areas that are subject to inundation by the 1 percent annual chance flood event.
- Other Flood Areas: Areas subject to inundation by the 0.2 percent annual chance flood or areas of 1 percent annual chance flood with average depths less than 1 foot or with drainage areas less than 1 square mile.
- Other Areas: Areas determined to be outside the 0.2 percent annual chance floodplain.

FEMA does not delineate floodplains for floods smaller than 1 percent-annual-chance floods, meaning floods that occur more frequently, such as 2- and 10-percent-annual-chance (50- and 10-year) floods. The SFHAs shown on these maps include areas described as "A" zones. Zone A means that flood elevations have not been determined for the area. Areas not in the "A" zones generally are less likely to flood because of ground elevation or protection by a certified levee or other protective feature.

In 2003, FEMA initiated a nationwide FIRM Modernization Project (FEMA 2010a). This project includes a strict review of levees protecting low-lying areas to ensure that they meet FEMA criteria for mapping a protected area as not being in a SFHA (i.e., not subject to inundation by a 1 percent annual chance flood).

Most areas of the Delta that were previously indicated as having 100-year protection (and therefore not included in SFHAs) are now having difficulty proving that their levees are adequate. Some areas—including West Sacramento and Reclamation District 17 in Lathrop—are initiating upgrade projects. Revised FEMA maps are being issued over the next several years.

5.3.5.1.2 FEMA Flood Areas

The following descriptions of communities in the Delta area are based on existing FEMA maps, which show floodplain delineations for areas subject to 1 percent annual chance floods:

- Antioch. The City of Antioch is located within Contra Costa County. The City of Antioch is mapped into the 1 percent annual chance floodplain from the San Joaquin River and its tributaries (FEMA FIRM Maps 06013C: 0139F, 0143F, 0144F dated June 16, 2009).
- Benicia. The City of Benicia is located in Solano County and adjacent to the Suisun Bay. Flooding from the Suisun Bay accounts for a portion of the 1 percent annual chance floodplain (Zone AE) mapped in Benicia (FEMA FIRM Maps 06095C: 0635E, 0633E, 0634E, 0642E, 0653E, and 0675E dated June 16, 2009).
- Clarksburg. Clarksburg is an unincorporated community located on the western bank of the Sacramento River in Yolo County. Clarksburg does not have official boundaries, but it is situated to the north of the confluence of Elk Slough and the Sacramento River and south of Winchester Lake. Clarksburg is located within a 1 percent annual chance floodplain (Zone A). Levees are located along the Sacramento River and Elk Slough but not along Winchester Lake. These levees are shown as not providing protection from the 1 percent annual chance flood (FEMA FIRM Map 06113C0745G dated June 16, 2010).
- Courtland. Courtland is an unincorporated community located on the eastern bank of the Sacramento River in Sacramento County. Courtland is located in the Pierson District, which is bordered by the Sacramento River to the west and north, Snodgrass Slough to the east, and Meadows Slough to the south. Courtland is protected from the 1 percent annual chance flood by levees along the Sacramento River, Snodgrass Slough, and Meadows Slough, and is not mapped in a 1 percent annual chance floodplain (0602620005C dated September 30, 1988 and 0602620010D dated February 4, 1998).
- Fairfield. The City of Fairfield is located west of the City of Suisun City within Solano County. The 1 percent annual chance flooding source is mapped for Fairfield from McCoy Creek, Ledgewood Creek, Union Avenue Creek, and Pennsylvania Creek. A small portion of the city is mapped in the 1 percent floodplain from adjacent sloughs in Suisun Marsh such as Suisun and Hill Sloughs. (FEMA FIRM Maps 06095C: 0452E and 0456E dated May 4, 2009).
- Lathrop. The City of Lathrop is divided by the San Joaquin River into two distinct land use sections: highly developed lands in the east and agricultural lands in the west. The area west of the San Joaquin River is subject to flooding by the 1 percent annual chance flood. However, the lands to the east are protected from the 1 percent annual chance flood by a levee along the eastern bank of the San Joaquin River, so this area is not mapped in a 1 percent annual chance floodplain. This levee is considered a Provisionally Accredited Levee (PAL), and levee owners or communities are required to submit the data necessary to comply with 44 CFR 65.10; otherwise, the levee can be de-accredited (FEMA FIRM Maps: 06077C: 0585F, 0595F, 0605F, 0610F, 0615F, and 0610F dated October 16, 2009).
- Locke. Locke is an unincorporated community located on the eastern bank of the Sacramento River in Sacramento County. Locke does not have any official boundaries, but its general area is mapped in a 1 percent annual chance floodplain. Levees around Locke line the Sacramento River

on the west, the Delta Cross Channel to the south, and Snodgrass Slough to the east, but do not protect it from the 1 percent annual chance flood (FEMA FIRM Map 0602620560C, dated September 30, 1988; Map 0602620420D, dated February 4, 1998).

- Manteca (western portion). The City of Manteca is located to southeast of the City of Lathrop. A portion of Manteca is protected from the 1 percent annual chance flood (from the San Joaquin River) by the Western Ranch South Levee, which is considered a PAL (see discussion for Lathrop); this area is not mapped in 1 percent annual chance floodplain. South of the Western Ranch South Levee, a relatively small portion of the city is mapped in the 1 percent floodplain (FEMA FIRM Map 06077C0620F dated October 16, 2009).

- Oakley. The City of Oakley is located in Contra Costa County east of the City of Antioch. This city is mapped in the 1 percent annual chance floodplain from the San Joaquin River and its tributaries (FEMA FIRM Maps 06013C: 0165F, 0170F, 0355F, and 0360F dated June 16, 2009).

- Pittsburg. The City of Pittsburg is located in Contra Costa County and is mapped in the 1 percent annual chance floodplain from the Suisun Bay. Flooding sources also include the San Joaquin River (FEMA FIRM Maps 06013C: 0118F, 0119F, 0120F, and 0139F dated June 16, 2009).

- Rio Vista. The City of Rio Vista is drained east-southeasterly by Marina Creek, Marina Creek Tributary, and Industrial Creek as they flow toward the Sacramento River. The portion of the city west of the Sacramento River is subject to the 1 percent annual chance flood (mapped in the 1 percent annual chance floodplain) because of flooding from the Watson Hollow and Cache Slough. The lower reaches of the Sacramento River are under the influence of tides. Severe flooding along this waterway could result when very high tides and a large volume of stream outflow occur coincidentally, and strong onshore winds generate wave action that would increase the flood hazard above that of the tidal surge alone (FEMA FIRM Maps 06095C: 0530E, 0424E, 0537E, 0541E, and 0539E dated May 4, 2009).

- Sacramento (Pocket Area). The City of Sacramento’s Pocket Area is located in the southern portion of the community. This community is bordered by Interstate 5 to the east and the Sacramento River to the south, west, and north. A levee located along the Sacramento River is shown as providing protection from the 1 percent annual chance flood; however, this levee is shown as a PAL; this area is not mapped in the 1 percent annual chance floodplain (0602660285G and 0602660305G dated December 8, 2008).

- Stockton (western portion). The City of Stockton is situated adjacent to a network of sloughs and canals that branch off the San Joaquin River. The western region of Stockton is protected from the 1 percent annual chance flood by levees along Bear Creek, Lower Mosher Creek, Fourteen-Mile Slough, Five-Mile Slough, Disappointment Slough, Calaveras River, Smith Canal, Stockton Deep Water Ship Channel, Burns Cutoff, and the San Joaquin River. Each of these levees is considered a PAL (see discussion for Lathrop); this area is not mapped in a 1 percent annual chance floodplain (FEMA FIRM Maps: 06077C: 0295F, 02315F, 0320F, 0435F, 0455F, 0460F, 0465F, and 0470F dated October 16, 2009).

- Suisun City (southern part). Suisun City is located in Solano County east of the City of Fairfield. A portion of the city is mapped in a 1 percent annual chance floodplain. These floodplains are attributed to Suisun Slough, McCoy Creek, and Union Avenue Creek (FEMA FIRM Maps 06095C: 0456E, 0457E, and 0476E dated May 4, 2009).

- Walnut Grove. Walnut Grove is an unincorporated community located on the eastern bank of the Sacramento River in the northern part of Tyler Island. It is protected from the 1 percent annual chance (100-year) flood by levees that line the Delta Cross Channel to the north and along the Mokelumne River to the south. This community is not mapped in a 1 percent annual chance floodplain.

- West Sacramento. The City of West Sacramento is currently designated as being protected from the 0.2 percent annual chance flood by levees that line the western bank of the Sacramento River (FEMA FIRM Maps 0607280005B and 0607280010B, dated January 19, 1995). However, FEMA is in the process of de-accrediting the city's levees. The northeastern portion of the city is close to the confluence of the American and Sacramento rivers, which is a FEMA-designated floodway. Levees are also located along the Yolo Bypass, Sacramento River Deep Water Ship Channel, and Sacramento Bypass.

As shown in Figure 5-4, FEMA maps indicate that much of the central Delta, essentially all of the non-urban Delta, is within SFHAs (mapped in the 1 percent annual chance floodplain) and considered to be subject to inundation by the 1 percent annual chance flood. The urban areas at the edges of the Delta (West Sacramento, Sacramento, Stockton, Mossdale, etc.) are working to preserve their levee accreditation and thereby avoid being designated as "A" zones.

5.3.5.1.3 DWR Analyses

DWR also incorporates a flood mapping program, which includes Best Available Maps, and Levee Flood Protected Zones. These programs are described below.

Best Available Maps

In response to recent flood legislation, DWR developed a collection of "Best Available Maps" of the 100- and 200-year floodplains using information available from earlier studies. The maps were required by Senate Bill 5 to be available by July 1, 2008, and they are available on the Internet (DWR 2010a). Maps are available for the entire Delta. An example of a portion of a map is shown in Figure 5-5 (DWR 2010b). In general, almost all of the non-urban Delta is shown to be part of the present 100-year floodplain (i.e., has less than 100-year flood protection). The maps were based on the FEMA FIRMs and subsequently revised based on FEMA's map modernization program. Best Available Maps also provide information on 200-year floodplains, to the extent available (see the rose-tinted areas north of Rio Vista). The maps distinguish between project and non-project levees (project levees have red and yellow lines on the maps).

Levee Flood Protected Zones

A second DWR product is a set of maps of Levee Flood Protected Zones. These maps "estimate the maximum area that may be inundated if a project levee fails when the water surface elevation is at the top of a project levee." Figure 5-6 shows the Delta portion of the Sacramento River Basin map that presents Levee Flood Protected Zones (DWR 2010c). Figure 5-7 shows the Delta portion of the San Joaquin River Basin (DWR 2010d). Although these areas have "protection" because of project facilities, they still have a "residual risk" because these facilities may be inadequate (the flood may be larger than the design flood) or the facility may fail for some other reason. Levees reduce the chance of flooding, but they do not eliminate it. Note that only areas protected by State-federal project levees are shown. Some areas that are expected to flood, such as the Yolo Bypass, are not highlighted. Similarly, areas that are protected only by non-project levees (much of the Delta) are not highlighted. The legislation only required DWR to show areas protected by State-federal project levees (i.e., the State Plan of Flood Control). Thus, the fact that an area is not highlighted does not mean it is adequately protected or will not flood. Therefore, many areas in the Delta with a high potential for flooding are not identified in Figure 5-7 because they are not protected by State-federal project levees.

1 Figure 5-4
2 Effective FEMA Flood Zones
3 *Source: FEMA 2010b*

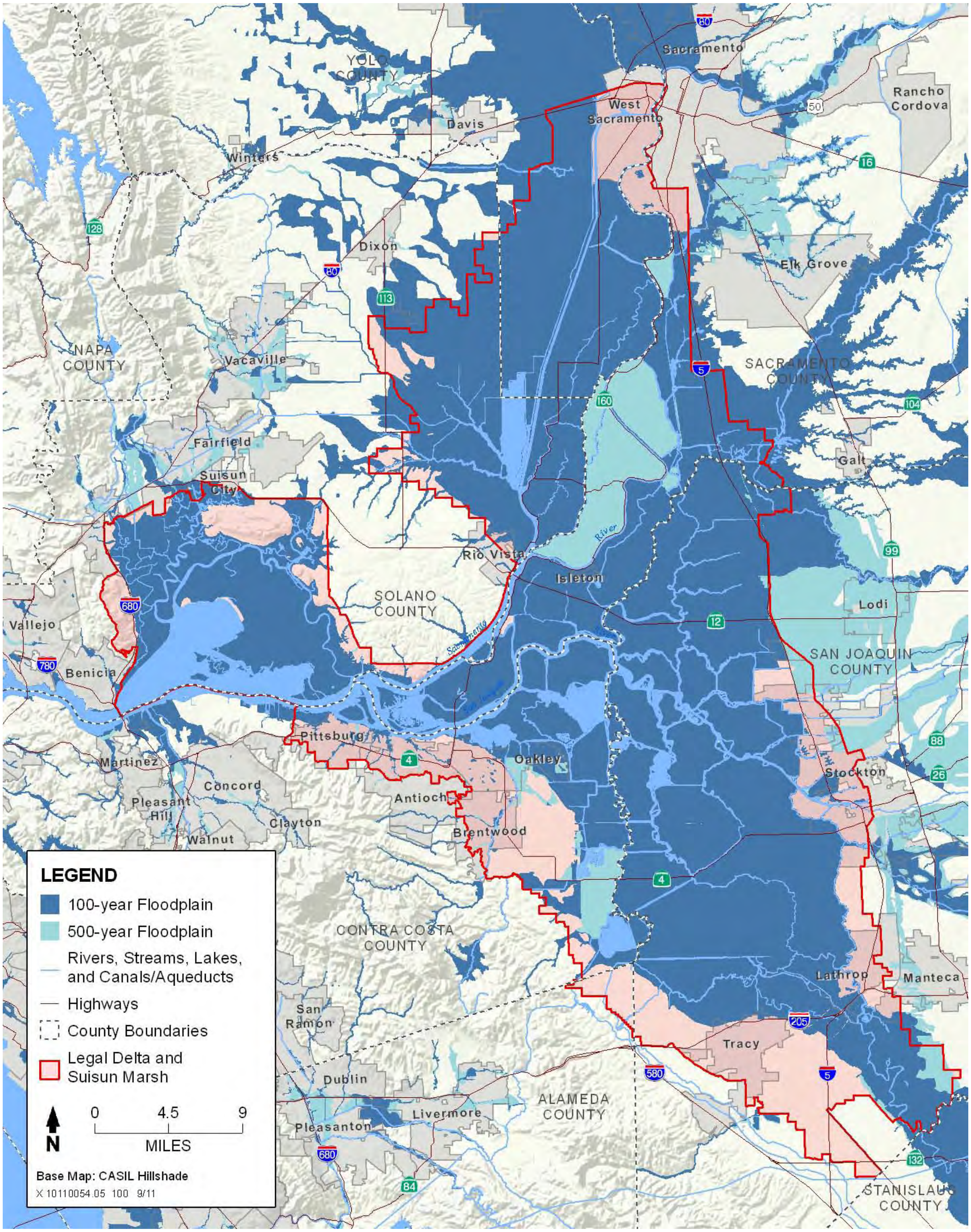
4 

Figure 5-5
DWR Best Available Map of 100- and 200-year Floodplains (example)
Source: DWR 2010b

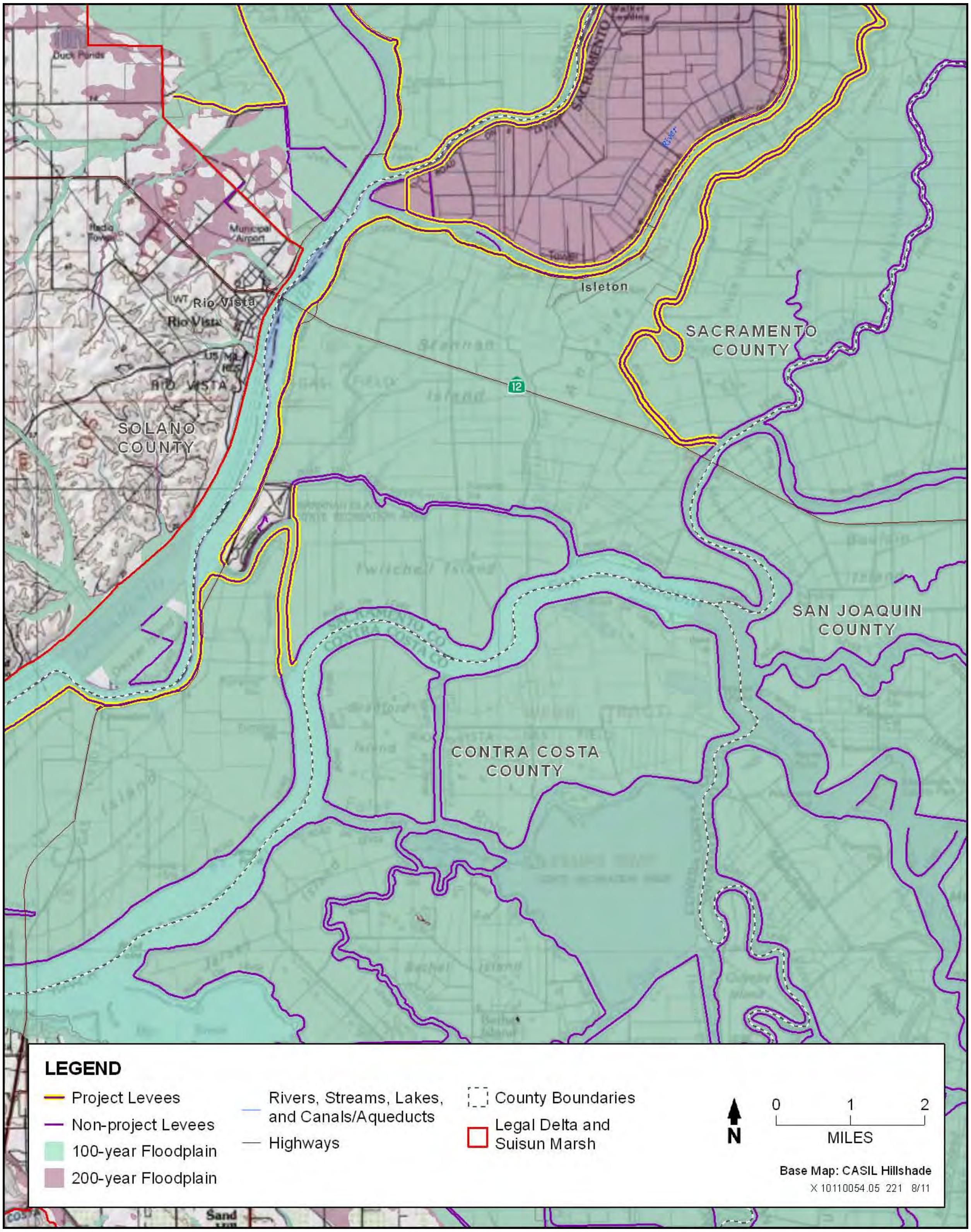


Figure 5-6
DWR Map of Levee Flood Protection Zones, Sacramento River Basin
Source: DWR 2010c

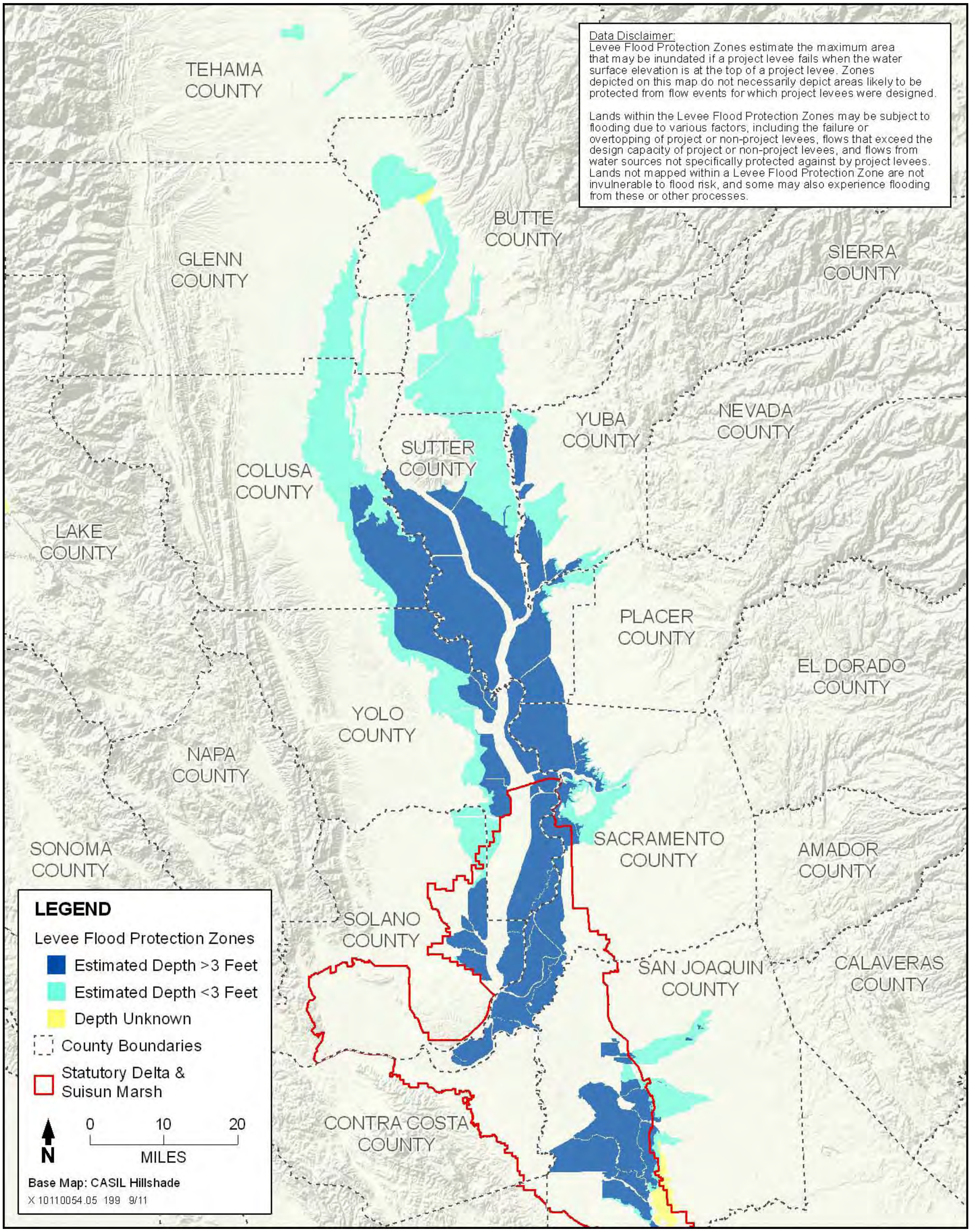
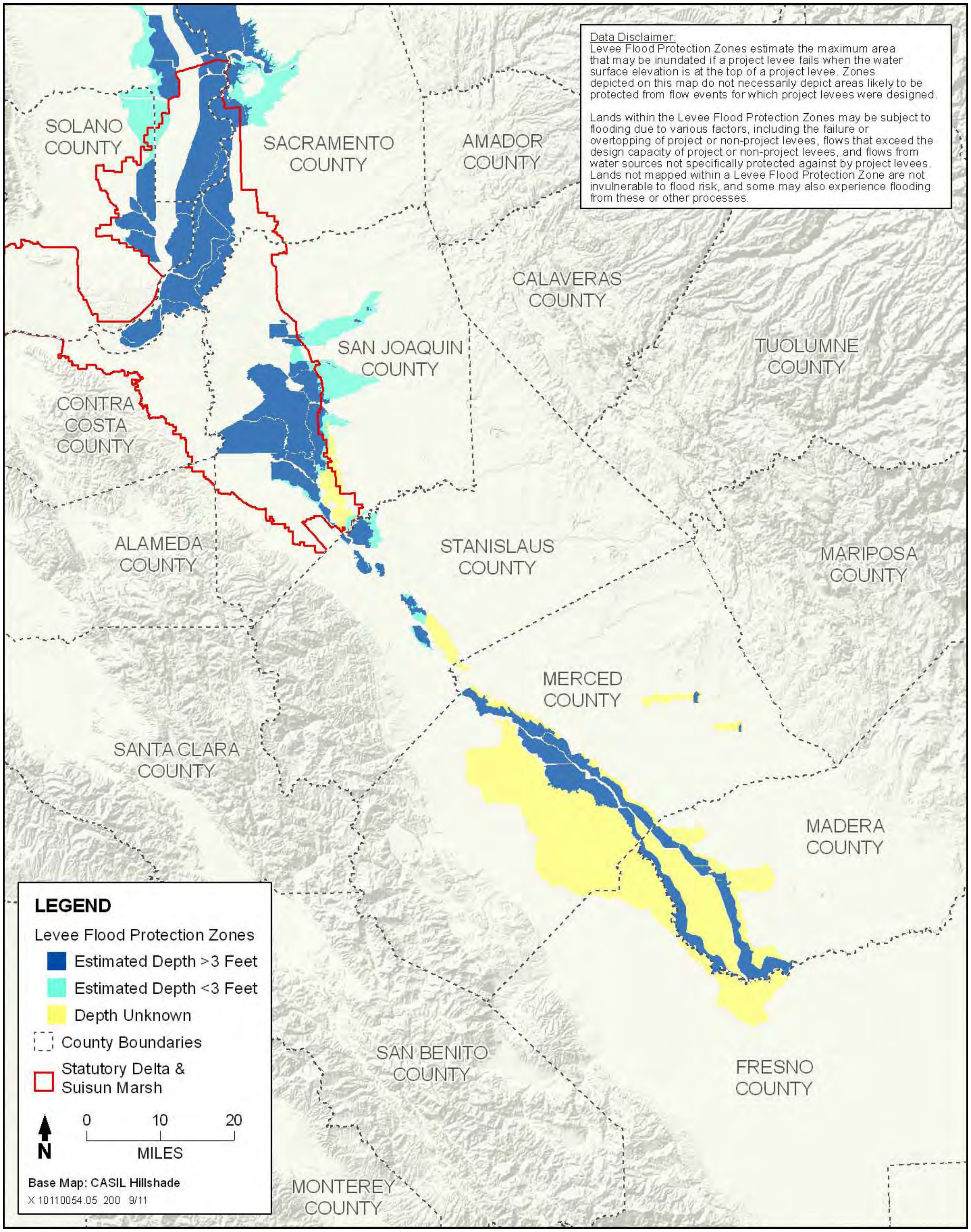


Figure 5-7
DWR Map of Levee Flood Protection Zones, San Joaquin River Basin
Source: DWR 2010d



5.3.5.1.4 Additional Analyses

The above maps are meant to communicate information about the present risk of flooding for any particular small area that people may be interested in, such as their homes. The chance of flooding is high for an area indicated to be in a FIRM SFHA. The chance of flooding may be less in a levee-protected area that is not in a SFHA, but this "residual risk" still needs to be considered. It should be noted that while the 100-year level of flood protection is equivalent to having an annual chance of 1 percent of flooding in any one year, the risk builds over time. Over the life of a 30-year mortgage, the 100-year level of flood protection equates to a 26 percent chance of flooding (about 1 out of 4), a relatively high risk.

To develop better information on flood and other Delta levee risks, DWR in the DRMS project considered the available information on the actual characteristics of Delta levees including crest elevations, geometry (height and slopes), and embankment and foundation materials (DWR 2008d). Integrating this information and many hypothetical floods, calculations were performed to see whether the levees might fail as a result of under-seepage, through-seepage, or overtopping. The result of this probabilistic analysis indicated about a 10 percent chance of annual flooding (10-year flood event) of up to four islands assuming a 50 percent confidence level. There was a 0.5 percent annual average chance of flooding (200-year flood event) of up to 34 islands assuming the same confidence level.

5.3.5.2 Earthquake Risks

The risk of earthquakes causing levee breaches and island inundations in the Delta have long been recognized. Due to the presence of nearby faults, including: (1) known active faults within the Project Area that have surface expression (discussed in Section 11.5.3.1.1); (2) known active faults within the Project Area that do not have surface expression (such as the Midland and Vernalis blind thrust faults); and (3) known regional active faults in the vicinity of the project area that have or do not have surface expression, strong ground motion during seismic events can and will occur within the Project Area in the future. However, no levee failures can be directly linked to earthquake loading because the levees in the Delta have not yet been subjected to strong earthquake loading. It is assumed that an earthquake in the area would pose a significant threat to the Delta water supply because of the potential for liquefaction of levee embankments and foundations. Saturated levees composed of dredged materials in other parts of the country and the world have performed poorly during moderate to strong earthquake shaking.

A key consideration in assessing the present potential for seismic failure of Delta levees is the potential mode of failure. Some Delta soils are commonly composed of and founded on marsh deposits (peat, silt, and clay) intermixed with sandy deposits of stream sediments. Some Delta levees were built on the marshy soils without foundation preparation or improvement. The embankments can have large areas of loose sandy soil, and the marsh-soil foundations may overlie loose to medium dense sands. Thus, either the levees or sublayers of their foundations can be sandy, unconsolidated, saturated materials that are susceptible to liquefaction during seismic shaking. If an embankment collapse were to occur during high flows or if a flood were to occur soon after an earthquake, the protected area could be inundated. In the tidal reaches of the Delta, where levees must hold water out of protected areas every day, islands could be inundated.

Liquefaction is not the only mode of seismic failure. Overly steep waterside levee slopes were identified as another potential weak feature that can lead to instability in an earthquake. However, most engineering assessments in the Delta have concluded that levee and foundation liquefaction are the most dominant potential modes of failure.

In the Delta, the peaty and organic soils are presumed to be unlikely to liquefy and lose significant shear strength. Rather, it is the sandy and silty soils in either loose levee fills or in foundation layers beneath the organic soils that are of a concern for liquefaction. In some areas, notably the south levees of Sherman and Twitchell islands, the levees are commonly composed of very loose and saturated sandy soils and are believed to be readily liquefiable.

In other areas of the Delta, the levee embankments are composed of more clayey or dense soils and are not as liquefiable. Also, in many areas of the Delta, the foundation sands beneath the organic soils are moderately dense and not easily liquefied. However, there are other areas where the marsh deposits were eroded out by pre-reclamation channels that left behind loose mineral soil deposits that may be extremely liquefiable.

5.3.5.3 Sunny Day and High-Tide Risk

Delta levees can also fail under conditions that are not attributable to floods or earthquakes. These failures, which may occur on sunny days and are sometimes associated with high tides, will occur sporadically. The DRMS study (DWR 2008d) states:

> *Generally, these failure events may be the result of a combination of high tide and pre-existing internal levee and foundation weaknesses caused by burrowing animals, internal compounded erosion of the levee and foundation through time, and human interventions such as dredging or excavation at the toe of the levee.*

Sunny-day failures are those that cannot be directly attributed to extraordinary loading events such as floods or earthquakes. These failures often occur during high tides and may be attributed to preexisting internal levee weaknesses caused by burrowing animals, internal piping, or human-made hazards such as channel dredging (DWR 1995). Examples of sunny-day failures include the Brannon Andrus Tract in 1972 and Upper Jones Tract in 2004. It is estimated that, based on current conditions, a sunny day failure would occur once every 9 years on average (DWR and DFG 2008).

The consequences of a sunny-day levee failure will vary, depending on which island fails, the time of year, and what improvements and infrastructure are impacted.

5.3.5.4 Other Hazards to Levees

Other hazards that affect the performance of levees within the Delta include encroachments, penetrations, excessive vegetation, burrowing animals, security issues, subsidence, and settlement.

5.3.5.4.1 Encroachments

Encroachments such as structures or farming practices on or close to the levee can adversely affect the levee. Examples are excavations at or near the toe leading to increased seepage and instability, and obstructions on the levee crown, which can interrupt access that is important for inspection, maintenance, and fighting floods. Another example is human activity, such as offroad vehicle use, which can reduce the integrity of the levee crown and slopes and also can lead to potential levee failure.

5.3.5.4.2 Penetrations

Penetrations of the levee, such as culverts or pipelines, can directly contribute to flooding if the waterside opening does not have an appropriate closure device; they can also form preferential seepage paths leading to excessive seepage and instability of the levee.

Because of unregulated historical construction, levees also contain many hidden hazards. These hazards (which could cause internal erosion) include abandoned sluiceways, drainage pipes and cables, concrete loading docks, fuel tanks, and storage drums (Johnson and Pellerin 2010).

5.3.5.4.3 Vegetation

Excessive vegetation on levee slopes increases the difficultly of properly inspecting the levees. Vegetation may also obstruct the toe and slopes and could impede access needed to fight floods. Recently, USACE has emphasized the importance of clearing vegetation that might overgrow the levees, especially on the waterside slope. USACE has recently issued a vegetation policy on federal levees in Technical Letter 1110-2-571 (USACE 2009). Issues may arise when root systems of older vegetation decay, leaving the potential for piping and internal degradation of the levee when water seeps in. Conversely, potential benefits of vegetation include energy absorption, reduction of erosion, and added stability attributable to root structure.

5.3.5.4.4 Burrowing Animals

The Delta provides an array of habitats, including marshlands, berms, and levees, for a variety of burrowing rodents (DWR 1982, p. 45). Burrows created by rodents, especially beavers, muskrats, and squirrels, can weaken the structural integrity of the levee and increase the likelihood of piping. Sunny-day levee failures may result from a combination of high tide and preexisting internal levee and foundation weaknesses caused by burrowing animals. Rodent activities and preexisting weaknesses in the levees and foundations are believed to have contributed considerably to past levee failures.

Wildlife that cause levee damage should be identified, and mitigation measures for each species should be implemented before levee operations are compromised (FEMA 2005, pp. 64–70). Rodent removal measures that traditionally have been used include poisoning and trapping. Burrow remediation measures include grouting and rebuilding of the levee.

5.3.5.4.5 Security Issues

Although there has been no information to indicate that terrorists have identified levees in the United States as an infrastructure target, the U.S. Department of Homeland Security and other groups agree that levee owners and operators should be aware of the potential threat. Thus, levee personnel should be aware of potential surveillance activities or attempts by recognizing the presence of strangers, unusual individuals in accessible areas, persons using cameras or video devices, unusual aircraft or boating activities, cuts in fencing or gates, persons approaching levee personnel, and theft of marked vehicles or uniforms (U.S. Department of Homeland Security 2009).

5.3.5.4.6 Delta Subsidence or Settlement

Subsidence is defined as the lowering of the ground surface through removal of surface or subsurface materials, such as by groundwater pumping or peat oxidation. A similar phenomenon is settlement, which is the lowering of the ground surface by an application of a load on the surface, such as fill placement on top of a levee or roadway construction. This latter phenomenon is associated with the compression of materials rather that their removal.

As the landside ground surface elevation decreases because of subsidence or settlement, the water level stays the same or rises over time due to sea level rise. This increase in pressure head through the levee foundation can cause serious issues with regard to seepage, piping, and slope stability. The theoretical volume of space between the ground surface and mean sea level within the Delta islands is referred to as “anthropogenic accommodation space” and is used to measure the effects of subsidence. The areas most susceptible to subsidence are the central, western, and northern Delta, where thick organic peat layers predominate (PPIC 2008b, p. 3). Three common types of ground surface lowering may occur: settlement of the levee due to the weight of the embankment, interior subsidence due to the biochemical oxidation of organic peat soils, and regional subsidence due to extraction of groundwater and natural gas. Additional details are provided in Section 11, Geology and Soils, and Section 13, Mineral Resources.

5.3.5.4.7 Levee Settlement

Settlement of soils beneath the existing levees and settlement of the levee embankment itself are generally caused by the reduction in soil volume through consolidation of soft, fine-grained soil or creep within the low shear strength organic foundation soils. The soil experiences increased pressure as the embankment is raised. Further consolidation and settlement occurs as repairs are made. Additional information regarding levee foundation subsidence and settlement can be found in Section 11, Geology and Soils, and Section 13, Mineral Resources.

5.3.5.4.8 Interior Island and Tract Subsidence

Subsidence is related to the intense farming and flood control activities within the Delta that have removed moisture from the surficial soils, which has allowed the highly organic peat soil to react with oxygen in the air to produce carbon dioxide and aqueous carbon (DWR 1995). This reaction allows the surficial soil to be displaced by wind. The loss of ground surface elevation due to wind is an important issue in assessing levee stability within the Delta. As the ground surface elevation is lowered, the landside slope of the levee becomes steeper and less stable. The lowered ground surface also increases the hydraulic loading on the levee and foundation.

5.3.5.1 Increased Risks to Levees Due to Climate Change and Sea Level Rise

As described in Section 21, Climate Change and Greenhouse Gas Emissions, climate change projections by federal and State agencies, international and national organizations, and numerous research institutions indicate that future storm patterns will change in the Delta watershed. Some of the projections indicate that more snow fall will occur than rain with increased river flows during the late spring and early summer as the snow melts. Other projections indicate that more rain will occur during the winter and cause increased river flows and flood potential. The specific volumes of flow and surface water elevations are currently being analyzed for the Delta watershed by DWR and USACE. Following these studies that are anticipated to be complete in several years, it is anticipated that future projects would be considered to increase flood protection.

Concurrently with climate change, it is anticipated that the sea level will rise (see Section 21, Climate Change and Greenhouse Gas Emissions). The extent and timing of sea level rise is not clear at this time. Most of the federal and State agency analytical models indicate that there could be a sea level rise of at least 6 inches by 2030 at the Golden Gate Bridge. The increased surface water elevation would require existing levees to be raised to accommodate sea level rise.

When considering future levee improvements for climate change and sea level rise, the improvements would need to consider both issues. This would be especially true for levees in the western Delta because those levees also must protect the islands from high waves that are driven by winds that blow in from the Golden Gate. If future storms are more powerful and extend for a longer period than historical storms, the combination of the high westerly winds, high tides with sea level rise conditions, and high flood flows could increase the potential of levee overtopping in the western Delta.

5.3.6 Current Levee Design Standards

Current levee standards are based on providing a prescribed level of safety and reliability. During the last few decades, State and federal agencies have developed various levee standards. These standards were designed to either establish minimum criteria that would make the levees and the properties protected eligible for grants or rehabilitation funds, or establish minimum criteria that would allow development behind the levees. Levees must be designed for reliable performance to meet various loading factors:

- Flood and tidal stages that will increase because of climate changes
- Current and wave action

- Continuing island subsidence
- Earthquakes
- Environmental factors such as vegetation growth (trees) and animal burrows

These are the four most prominent existing standards:

- FEMA Hazard Mitigation Plan: The Hazard Mitigation Plan design standards (based upon geometric criteria for the levees) were negotiated by the FEMA, DWR, California Office of Emergency Services (OES), and the Delta Levee Maintaining Agencies between 1983 and 1987 to establish a minimal, short-term interim standard to reduce the risk of repeat flood damage. Although this standard was to be an interim standard, no adjustments based on subsequent or projected flood elevations have been used to modify the standard. Meeting this standard allows the Delta island or tract to be eligible for FEMA disaster grants and assistance following levee failures and island inundation. If even a portion of the levee around the island or tract does not meet the Hazard Mitigation Plan standard, the FEMA will deny claims for levee damage.

- USACE Public Law 84-99: The Public Law 84-99 standard is a minimum requirement for all federal flood control project levees, such as the Sacramento or San Joaquin River Flood Control Projects. The standard was developed for major rivers, such as the Mississippi River, and was not necessarily appropriate for the non-federal flood control project levees. In 1987, USACE developed a Delta-specific standard based on the Delta organic soils and levee foundation conditions. Compliance with this standard allows for USACE emergency assistance for levee rehabilitation and island restoration following levee failures and island inundation, provided the reclamation district applies for and is accepted into the program and passes a rigorous initial inspection and periodic follow-up inspections.

- FEMA 100-year (Base Flood) Protection: This standard, often called the 1 percent annual chance flood level of protection, is based on criteria established in the Code of Federal Regulations and is often used with established USACE criteria to meet certain freeboard, slope stability, seepage/underseepage, erosion, and settlement requirements. Numerical hydrologic models are used to project surface water elevations at different locations in the rivers for the statistically probable 100-year flood event. Model runs are updated periodically to reflect changes in river bathymetry and historical hydrology. Meeting this level of flood protection means that communities will not require mandatory purchase of flood insurance for houses in the floodplain or be subject to building restrictions. This standard generally does not address seismic stability. Currently, FEMA 100-year criteria are based on historical conditions and do not include considerations for climate change or sea level rise. FEMA is currently completing a study on the Impact of Climate Change on the National Flood Insurance Program (FEMA 2010c) to determine how to accommodate these factors and the long-term implications. This report is to be submitted to Congress in 2011.

- DWR 200-year Urban Levee Protection: This standard is similar to the FEMA standard, but for a 200-year level of flood protection. This standard is developed in a similar manner as the FEMA 100-year but requires design for a 200-year flood event. It is generally based on established USACE criteria. The DWR 200-year Urban Levee Protection also requires that seismic stability be addressed. Not meeting this standard, or not making adequate progress towards it, will generally prohibit further development in an urban or urbanizing area with populations exceeding or approaching 10,000 after 2025 in accordance with the Central Valley Flood Protection Act of 2008 (Government Code section 65865.5(a)(3)).

5.3.7 Emergency Management

Although existing levees are being improved and new levees are being designed to reduce risk in the Delta, existing land uses and communities need to be protected from current and future flood risk through emergency management and preparedness.

5.3.7.1 Phases of Emergency Management

In its 2006 report, *Safeguarding the Golden State: Preparing for Catastrophic Events*, the Little Hoover Commission summarized the four phases of emergency management: preparation, response, recovery, and mitigation (Little Hoover Commission 2006).

5.3.7.1.1 Preparation

Preparation involves activities undertaken in advance of an emergency. These activities include developing operational capabilities, training, preparing plans, and improving public information and communication systems. Planning for events during this phase is critical. Disasters do not happen all in the same way in either scale or impact. During the preparation phase, emergency managers need to determine the best methods of responding to various sizes and types of disasters. Most local emergencies can be handled by local agencies, such as a structure fire, traffic accidents, and small-scale hazardous material spills. If the emergency is larger, such as a major oil spill resulting from a commercial shipping accident, it may require a coordinated response. Catastrophes require response by multiple agencies, each with specific expertise.

5.3.7.1.2 Response

Response is that phase where actions are taken to save lives and protect property during an emergency or disaster and also to gain control of disaster-propagated forces and their impacts. This phase can be further divided into three progressive stages: pre-impact response, immediate impact response, and sustained response.

Pre-impact Response

With the warning of a potential disaster, such as a weather forecast, emergency managers can take actions to save lives and protect property before the disaster happens. Depending on the forecasts and predictions, evacuations may begin.

Immediate Impact Response

During this stage, emphasis is placed on saving lives, controlling the situation, and minimizing the effects of the disaster. Mutual aid requests are made and initial assessments about the size of the response is determined and communicated to local, regional, and State emergency managers.

Sustained Response

This stage usually begins after the scope of the emergency has been determined and initial control has been established. During this stage, assistance is provided to victims of the disaster, and efforts are made to reduce secondary damage to property and the environment. Regional or statewide mutual aid may be provided to assist with these efforts.

5.3.7.1.3 Recovery

Recovery is a phase with both short-term and long-term aspects. At the beginning of an emergency, emergency managers begin recovery efforts. Short-term recovery efforts include restoring vital life-support systems; long recovery efforts focus on returning infrastructure systems to pre-disaster conditions. This phase also includes cost recovery efforts. In many instances, cost recovery is managing the flow of funding from higher levels of government (federal and State) to lower levels (State and local) for the cost of services (e.g., overtime pay for emergency personnel) rendered during the disaster that are determined to be beyond an organization's responsibility.

5.3.7.1.4 Mitigation

The mitigation phase involves those efforts to lessen the effects of future disasters. In this phase, responsible agencies, organizations, and individuals take actions to reduce the number of potential victims, property loss, and environmental damage. This is accomplished by identifying and reducing the principle causes of injuries and death, and by lessening the impacts of disasters on community infrastructure and societal structure. Mitigation, if done correctly, will decrease demands for emergency response resources in the future and is important for sustainable community development.

5.3.7.2 Emergency Response Authorities and Responsibilities

Responsibilities for preparing for, declaring, and responding to emergencies are distributed among local, State, and federal agencies. Federal agencies with authority include USACE and FEMA. In California, State and local responsibilities fall to a county's OES, local reclamation districts, the California Emergency Management Agency (Cal EMA), and DWR. Delta Multi-Hazard Coordination Planning (Senate Bill 27) and Delta Protection Commission are also discussed in this section.

5.3.7.2.1 Local Emergency Preparedness and Response

Local responsibilities fall to the county OES and local reclamation districts. A county's OES is usually designated as the central authority for coordinating activities for an Operational Area in a complex emergency and usually does so through an Emergency Operations Center (EOC). When an EOC is activated, it is usually because for the following reasons (Cal EMA 2010a):

- Local resources (e.g., a reclamation district) are exhausted.
- The emergency is of long duration.
- Major policy decisions will or may be needed.
- A local or state emergency is declared.
- Activation of an EOC will be advantageous to achieving a desirable outcome.

San Joaquin County, for example, has a "Flood Evacuation Plan" (San Joaquin County OES 1995). This plan, dated 1995, is the most recent plan published on the San Joaquin County's Office of Emergency Services (OES) website. It indicates county responsibility for ensuring public safety through evacuation and identifies the specific responsibilities of county agencies during flood emergencies. These include the relevant public safety agencies (law enforcement and fire), the OES, Public Works (traffic), and support organizations such as Red Cross. The county OES has an established procedure for notifying the public of a need to evacuate. It also indicates that the county will "provide mutual aid to reclamation districts for flood-fight activities to the extent possible."

Although a county's OES has planning responsibilities for planning for and coordinating emergency responses, reclamation districts usually have the primary day-to-day responsibility for the integrity, improvement, operations, and maintenance of the Delta levees. They are the first responders relative to Delta flood hazards, and therefore have primary responsibility for preparedness and immediate response to flood threats. For some project levees, the State has this responsibility or works very closely with a local reclamation district. The reclamation district is generally the organizer of levee patrols in high hazard situations (high tides, wind and wave events, and high water due to high Delta inflows). Many reclamation districts have material and some equipment available for conducting flood fights should the need arise. They have established communications protocols for informing other relevant authorities. These include the county OES and the DWR Joint Flood Operations Center.

Beyond responsibility and concern for levee integrity, these local agencies obviously place high priority on the safety of district occupants, and on protecting property. The preferred approach is to prevent a levee failure, and thereby ensure resident safety and prevent property damage. When there is an imminent danger of a levee breach or when a breach has begun, evacuation becomes necessary. The reclamation districts would notify the county OES of the situation they are experiencing in the field, the appropriate authority would decide on evacuation, and then local law enforcement (usually the county sheriff or a deputy) and other local organizations, such as volunteer fire departments and the reclamation district would be active participants in facilitating evacuation. However, the degree of planning and preparedness varies widely between reclamation districts.

In addition to serving as the designated central authority for coordinating activities during an emergency, the San Joaquin County OES has facilitated and funded development of contingency maps by reclamation districts to improve situational awareness, analysis, and decision making when levee integrity is jeopardized. These maps can be downloaded and viewed from a dedicated website (San Joaquin County OES 2011). An example of such a contingency map is given in Figure 5-8 for Bacon Island.

San Joaquin County Office of Emergency Services

The contingency maps are further described as:

> *These contingency plans have taken the form of "flood contingency maps" completed for areas with a common hydrological threat. The innovative mapping format displays information in relation to the most important component of floods, geography. The maps have been a highly successful method of sharing information and improving joint operations. The maps display historical, critical topographical, and survey information that are needed for effective situation analysis and decision-making. The maps also display pre-identified joint coordination processes and pre-determined engineering options for reducing flooding impact.* (Baldwin 2010)

The San Joaquin County OES has further facilitated preparedness by voluntarily assuming responsibility for assisting reclamation districts in meeting their command and coordination responsibilities in an actual flood. Several Delta "joint flood fight commands" have been created that provide the basis for joint command and coordination activities between the many reclamation districts and State and federal agencies directly supporting their flood fight operations. The OES directly facilitates the operations of these joint commands (Baldwin 2010).

A map of the San Joaquin County Joint Flood Fight Commands is shown in Figure 5-9.

5.3.7.2.2 State of California Emergency Preparedness and Response

The Cal EMA was established by the California Emergency Services Act of 2009. In this Act, the Legislature merged the OES and the Department of Health Services into the newly formed agency. Cal EMA consolidates emergency management and anti-terrorism programs to more effectively and efficiently serve the people and political subdivisions of California. This integrated approach to emergency management and terrorism preparedness is designed to further strengthen the State's ability to address disasters, emergencies, and terrorist events in an all-hazards approach.

Figure 5-8
Contingency Map, Bacon Island
Source: San Joaquin County OES 2010a

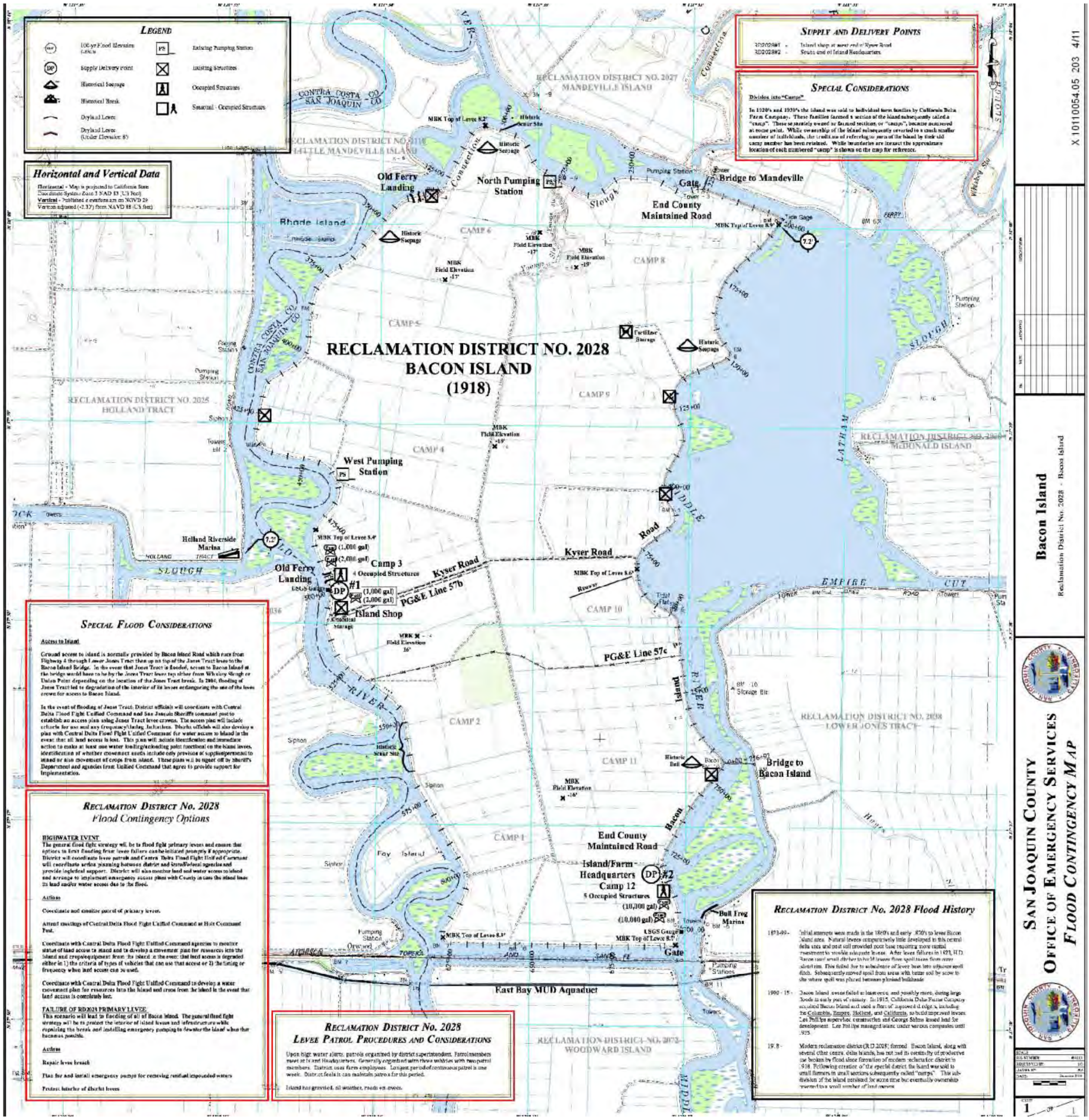
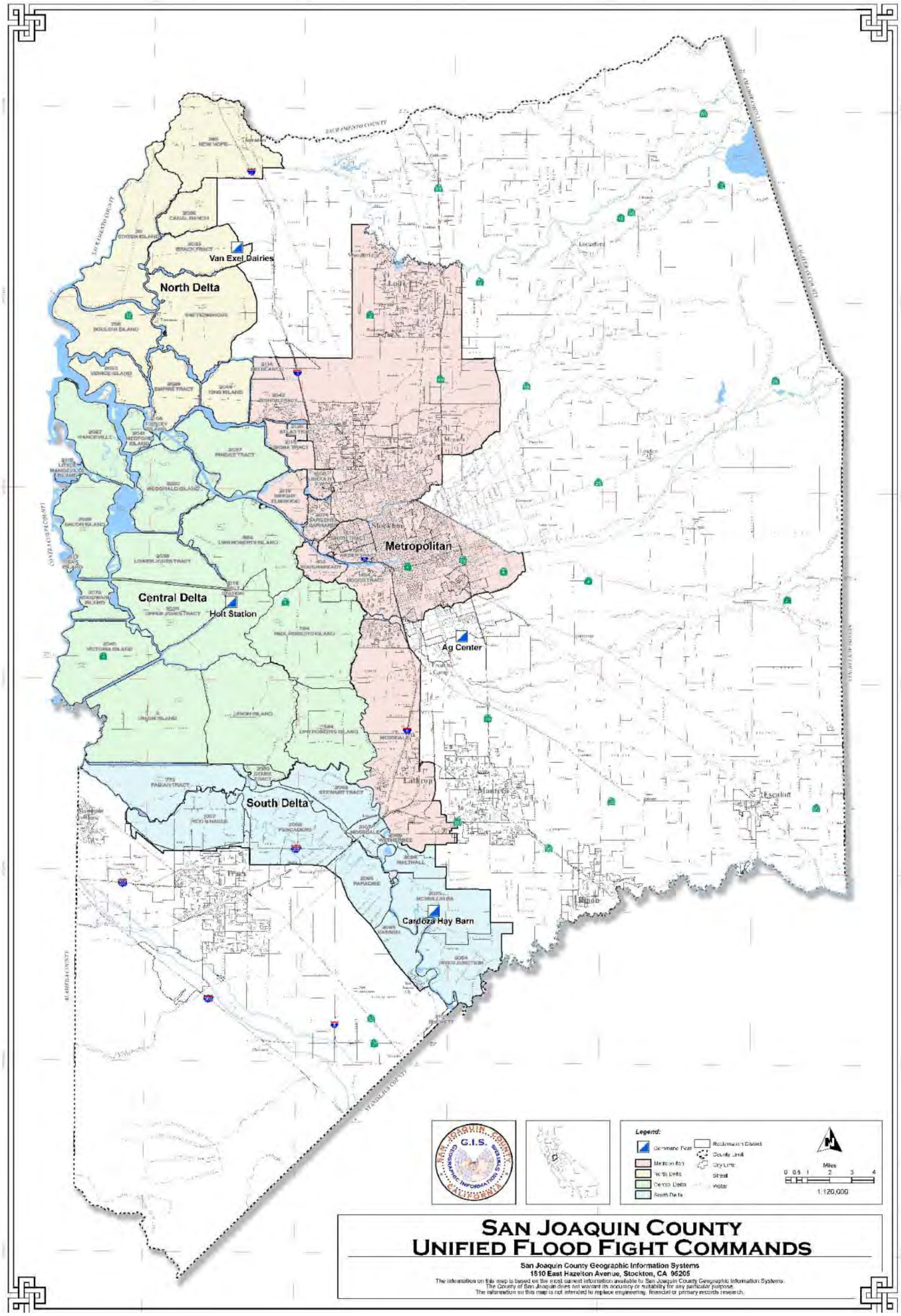


Figure 5-9
Joint Flood Fight Commands
Source: San Joaquin County OES 2010b



X 10110054.05 204 4/11

Cal EMA's mission is to protect lives and property by effectively preparing for, preventing, responding to and recovering from all threats, crimes, hazards and emergencies (Cal EMA 2011). In support of this mission, the Governor promulgated the 2009 edition of the State of California Emergency Plan (Emergency Plan) (Cal EMA 2009). The Emergency Plan outlines a State-level strategy to support local government efforts during a large-scale emergency. In accordance with the California Emergency Services Act, this plan describes:

- Methods for carrying out emergency operations
- The process for rendering mutual aid
- Emergency services of governmental agencies
- How resources are mobilized
- Emergency public information
- Continuity of government

The Emergency Plan addresses the State's response to emergency situations associated with natural disasters or human-caused emergencies. The concepts presented in this plan emphasize mitigation programs to reduce the vulnerabilities to disaster and preparedness activities to ensure the capabilities and resources are available for an effective response. To assist communities and governments to recover from a disaster, the plan outlines programs that promote a return to normalcy.

The State Emergency Plan incorporates and complies with the principles and requirements found in federal and State laws, regulations and guidelines. It is intended to conform to the requirements of California's Standardized Emergency Management System (SEMS) and the National Incident Management System (NIMS). It is also intended to be consistent with federal emergency planning concepts such as the National Response Framework (NRF) and catastrophic concept of operations (CONOPS) documents developed jointly by FEMA Region IX and the State.

The Exercise Branch of Cal EMA develops, coordinates, and leads a statewide Homeland Security Exercise and Evaluation Program primarily focused on weapons-of-mass-destruction (chemical, biological, radiological, nuclear, explosive) and catastrophic incidents. A primary effort of the Exercise Branch is the conduct of the Governor's annual statewide exercise series, "Golden Guardian." The goal of the Golden Guardian exercise series is to support the development and testing of emergency operations plans and annexes for catastrophic incidents from the local through regional, State and federal levels.

Working closely with all its exercise partners, the Training and Exercise Division has established "themes" for future year Golden Guardian exercises. Exercise planners at all levels can use these themes to develop their own multiyear exercise plan that is synchronized with the State's multiyear plan, thus consolidating and synergizing precious time and resources to test and evaluate common emergency management capabilities and objectives. The primary theme for 2011 is statewide flooding.

The mission of DWR's Division of Flood Management is to prevent the loss of life and reduce property damage caused by floods. As a component of the Division of Flood Management, DWR coordinates flood operations with various federal, State, and local agencies and operates the State-federal Flood Operation Center (FOC) in Sacramento, which provides the necessary components for a statewide emergency response in the event of a natural disaster. The National Weather Service and DWR monitor storm weather systems for forecasted or actual flooding. Under the guidance of the SEMS, the FOC will be activated during such flood warnings or events to carry specific functions such as the following:

- **Management**: The FOC is responsible for overall policy and coordination of flood response management. The FOC is the clearinghouse of requests for emergency support, especially for flood fighting as well as the repair and rehabilitation of flood damaged infrastructure such as levees.

- **Operations**: The FOC will coordinate the field operation units for flood fights and emergency repairs. Operations will also dispatch flood fight incident commanders.
- **Planning**: Responsible for disseminating flood emergency information through preparation of reports and formulation of action plans.
- **Logistics**: Makes available necessary services and support personnel as well as equipment and facilities in support of all operations of the FOC.

The DWR Branch Chief is the FOC's primary liaison with Cal EMA on flood events, potential high-water situations, and other flood emergency issues. The Flood Operations Branch works year-round on emergency preparedness and coordination, and conducts pre-season workshops.

The State FOC coordinates flood response activities, including Delta high water and levee emergencies. When activated during flood emergencies, flood incidents, or other high-water events, depending on the scale of the event, the center is staffed in compliance with SEMS with additional personnel from other branches within the DWR and cooperating agencies. It disseminates flood forecasts and warnings to the public. During emergency situations, the FOC is the facility from which the DWR centrally coordinates emergency response.

Year-round, the FOC is the focal point for the gathering, analysis, and dissemination of flood and water-related information to stakeholders. It also tracks incidents with potential flood impacts.

Delta Interim Emergency Operations Plan

DWR has developed a "Delta Emergency Operations Plan Concept Paper" (DWR 2007) that inventoried and assembled available Delta emergency operations information and supplemented it to create a Delta Interim Emergency Operations Plan. It was intended for use by the DWR in considering and responding to near-term Delta emergencies. The document was considered to be a first step in developing a more detailed plan that would include more stakeholder input, more extensive preparedness measures, and more sophisticated mechanisms for analyzing and choosing appropriate response strategies and organizing the implementation of a response. It recognizes the paramount priority of human life in emergencies (rescue, evacuation, and medical care) and the associated objective of reducing property damage. It defers to the agencies within the established Incident Command Structure that have expertise and responsibility for rescue, evacuation, and medical care (e.g., Cal EMA; California Department of Forestry and Fire Protection; California Highway Patrol; U. S. Coast Guard; and local OES, law enforcement, and fire). However, DWR recognizes its legal responsibility to participate in and assist those endeavors in accordance with SEMS priorities, especially to protect people's lives. The final plan will be a Delta-specific Integrated Flood Emergency Operations Plan (Delta IFEOP). The Delta IFEOP will be an integration of existing plans, agreements, and processes between local, State, and federal emergency responders.

The Delta IFEOP concentrates on DWR's primary responsibilities for flood fighting, levee repair, and maintenance and restoration of Delta water quality and water supply resources. It identifies specific response actions, especially relative to flood fights and water quality, and provides summary sheets on each. The response actions are categorized as immediate (first day), short term (days 2 to 5), mid term (days 6 to 14), and long term (15 days or later) based on when the action would likely be effective and implemented. A summary sheet is provided for each action and indicates a responsible party, a description of the action, the Delta region affected, the timeframe, expected impacts, constraints, and additional comments. The sheets provide an accessible resource for emergency personnel to use in understanding the action, assessing its applicability, and implementing it, if appropriate.

Delta Flood Emergency Preparedness, Response, and Recovery Program

DWR is continuing to enhance its emergency preparedness and response capabilities through an ongoing program. The program is designing and implementing in-Delta storage and transfer sites for rock and other flood-fight material. It is also performing studies to develop emergency analysis tools and response strategies so the Incident Management Team can anticipate incident progression in response to various control factors. Finally, it is preparing documents for assisting emergency managers in recognizing action alternatives and evaluating their associated decisions. The program is scheduled to be completed by 2014 (DWR 2011b).

Delta Multi-Hazard Coordination Planning (Senate Bill 27)

In 2008, the Delta Protection Commission (DPC) and the Governor's OES (now Cal EMA) together issued their Phase I Report on "A Strategy for Collaborative Emergency Response Planning in California's Delta Region" (CCP 2008). The Phase I Report provided a draft work plan for further collaboration on an emergency planning process. Near that time, Senate Bill 27 was passed, establishing the Sacramento–San Joaquin Delta Multi-Hazard Coordination Task Force (Task Force), to be led by the OES, and to include the DPC, DWR, and a representative of each of the five Delta counties. Senate Bill 27 directed the Task Force to:

> *Make recommendations to the OES relating to the creation of an interagency unified command system organizational framework in accordance with the guidelines of the NIMS and the SEMS.*
>
> *Coordinate the development of a draft emergency preparedness and response strategy for the Delta region for submission to the Director of the OES. Where possible, the strategy shall utilize existing interagency plans and planning processes of the involved jurisdictions and agencies that are members of the Delta Protection Commission.*
>
> *Develop and conduct an all-hazards emergency response exercise in the Delta, designed to test regional coordination protocols already in place.*

The Task Force was to submit its report and go out of existence on or before January 1, 2011, but this deadline was recently extended to January 1, 2013, by Senate Bill 1443 (2010). A public draft is not yet available.

The Task Force held its most recent public meeting on October 14, 2010, at Cal EMA. The following is a summary of discussion topics provided by the Delta Stewardship Council (Council) staff member who attended:

- Review of status of the Task Force
- Review of the draft Multi-Agency Coordination System (MACS)
- Discussion of need for funding to support ongoing exercise program and emergency response planning for the Delta
- Strategy is to include MACS and coordinate with flood emergency planning efforts under way with the USACE and DWR
- Discussed Delta evacuation planning under way
- Covered the overall Senate Bill 27 strategy which will be considered for inclusion within the Delta Plan
- Discussed the May 2011 Golden Guardian exercise

From the content of the DPC/OES Phase I Report (CCP 2008) and the mandate in Senate Bill 27, it is clear that the organizational framework and the strategy will build off of the structure established by the NIMS, and California's SEMS. This will include such features as countywide operational areas (led by the county OES) and coordination of response efforts by local agencies within the county, including the reclamation districts. A draft Delta-wide MACS Operations Guide is available (Cal EMA 2010b). It is expected to be further refined and recommended by the Task Force as the "Interagency Unified Command System Organizational Framework" for Delta Emergency Response, as required by the legislation.

The State's interest in the Delta focuses on the coequal goals of water supply reliability and protection of the Delta ecosystem. Related to the coequal goals are interests in the Delta "as a place" and flood protection, which also protects life and property. Currently, there is no integrated, substantive strategy for Delta emergency preparedness and response that addresses these complex and (in many ways) intangible interests. Although the Task Force has authority to propose a strategy, considering the interests of various stakeholders and making the required tradeoff decisions is complicated and may seem overwhelming. Some interests, such as protection of the Delta ecosystem, are not represented. For the ecosystem, there are real limits to our knowledge of how various levee breach scenarios may impact the ecosystem and what response and repairs would be most effective in helping the ecosystem recover (see DWR 2008d).

The Task Force's "draft emergency preparedness and response strategy" is embedded in the draft MACS Operations Guide. It includes two major components: a process for allocating scarce resources, and a statement of pre-agreed priorities. Quoting from the draft Operations Guide (Cal EMA 2010b), these elements are:

> ***Process –*** *For expediency and control, decisions on allocations of scarce resources in the MACS will be made through a consensus process of all jurisdictions and agencies that either utilize or provide these resources within the impacted area. Teleconferences and electronic communications of materials prior to each meeting will provide the documentation of support for the outcome. With an announcement of the conference call, all parties involved will be provided with forms to identify the incidents in their jurisdiction and their priorities….*
>
> ***MAC Resource Priorities –*** *Prioritization of competing resources per incident is similar whether the event is a fire, flood or other hazard scenario. Criteria for prioritization in descending order are as follows:*
>
> 1. *Life Threatening: The population of an area that would be affected, or is being affected, by a hazard (e.g., levee failure or flooding, etc.).*
> 2. *Public Property / State Assets and Systems Threatened: Highways, pipelines, water systems, bridges, and other public assets that have a regional or statewide importance; the loss of which would threaten public health and welfare outside of the Delta or ensure significant economic loss.*
> 3. *High Damage Potential: Existence of housing, farming structures, and other privately owned property in the area directly affected.*
> 4. *Incident Complexity: Potential impact on areas surrounding the area directly threatened. Potential for cascading events such as a levee failure causing a chain of levees to fail or widening impact form current level of threat. Complexity of the levee or other problem and needs for eliminating the threat and returning the site to normal.*

Thus, the Task Force strategy apparently depends on a predefined priority system to be applied through consensus decision making involving all jurisdictions and agencies that either utilize or provide these resources within the impacted area. The key to success for Task Force's approach is whether this can produce an effective overall response strategy for whatever complex Delta emergency occurs.

Delta Protection Commission

The mission of the DPC is to adaptively protect, maintain, and, where possible, enhance and restore the overall quality of the Delta environment consistent with the Delta Protection Act and with the Land Use and Resource Management Plan for the Primary Zone. This includes, but is not limited to, agriculture, wildlife habitat, and recreational activities. The goal of the DPC is to ensure orderly, balanced conservation and development of Delta land resources and improved flood protection.

Although the DPC does not have an emergency management authority or responsibility, it has been assisting with the collaboration among the five counties, DWR, and Cal EMA to develop an integrated and unified approach for emergency preparedness in the Delta. Its initial efforts culminated in a Phase 1 Report authored by the Center for Collaborative Policy (CCP 2008). The effort is being continued through the Delta Multi-Hazard Coordination Task Force.

5.3.7.2.3 Federal Emergency Preparedness and Response

FEMA has the primary purpose of coordinating the response of several federal agencies to a large natural disaster that overwhelms State and local authorities. The primary duty of FEMA is to ensure services to disaster victims through operational planning and integrated preparedness measures.

The Department of Homeland Security was issued the Homeland Security Presidential Directive Number 5 in 2003 to establish a single comprehensive NIMS. Working closely with many different levels of government to arrange a coordinated response to emergencies, the Department of Homeland Security and FEMA under the NIMS have developed the National Response Framework (NRF). As the ranking federal guidance, NRF stands as the policy for all response partners to follow in the event of a domestic emergency to provide the effective response to disaster victims. One of the documents that govern the NRF's direct response to a national emergency is the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 (Stafford Act).

The Stafford Act outlines how the federal government provides disaster and emergency assistance to states, local governments, tribal nations, eligible private nonprofit organizations, and individuals affected by a declared major disaster or emergency. After the President of the United States issues a disaster or emergency declaration, any federal agency can be directed to use its available personnel, equipment, supplies, facilities, and other resources in support of state and local disaster assistance efforts. In the event of an escalating emergency and to achieve an effective response time, a pre-deployment or staging of federal agencies' resources can be initiated (before the President's emergency declaration) to expedite the response to save lives and protect property. After the President declares an emergency, the Stafford Act requires the establishment of a Federal Coordination Office to coordinate the response of the federal agencies to the affected state and local governments. Beyond the response plan, the Stafford Act also includes recovery aid to state and local governments. Such aid is available to individuals affected by the disaster, as well as state and local governments for the repair of public infrastructure.

The USACE, under the regulation of the Flood Control and Coastal Emergences Act (Public Law 84-99), is authorized to undertake immediate action in the case of a national emergency. A few of these emergency actions are advanced measures, emergency measures (flood response and post-flood response) and rehabilitation of flood control works threatened or destroyed by flood. Public Law 84-99 allows the USACE to support state and local governments in flood fighting in urban and other nonagricultural areas as required under USACE guidance. Under the Stafford Act (Public Law 93-288, as amended), USACE is required to support FEMA as the federal agencies that manage the preparedness activities for emergencies and disasters. Engineer Regulation 500-1-1 (ER 500-1-1) provides specific details of the Civil Emergency Management Program's roles and responsibilities as a Federal emergency response partner (USACE 2001). ER 500-1-1 is the USACE guidance for the emergency employment of the Army and other resources in the event of a crisis. The scope of emergency and disaster assistance is geared toward preservation of life and the protection of residential and commercial developments, including public and private facilities that provide public services. In the event a flood fight is required, the USACE response will be temporary in nature to meet the immediate dangers of the event, supplementing the states' response.

5.4 Impacts Analysis of Project and Alternatives

5.4.1 Assessment Methods

The Proposed Project and alternatives would not directly result in construction or operation of projects or facilities, and therefore would result in no direct impacts on flood management resources. The Proposed Project and alternatives could ultimately result in or encourage implementation of actions or development of projects, such as facilities or infrastructure, as described in Section 2A, Proposed Project and Alternatives. Examples of potential actions that could affect flood management include water supply operations changes that could change flows and flow patterns in the Delta, land use changes that would encourage conversion of agricultural lands to floodplain expansion or tidal marsh restoration, and reoperation of upstream reservoirs to improve flood management. Projects may include water and wastewater treatment plants; conveyance facilities, including pumping plants; surface water or groundwater storage facilities; ecosystem restoration projects; flood control levees; or recreation facilities. Implementation of these types of actions and construction and operation of these types of facilities could result in changes to the flood management conditions of the places in which they would be located.

The precise magnitude and extent of project-specific impacts on flood management resources would depend on the type of action or project being evaluated, its specific location, its total size, and a variety of project- and site-specific factors that are undefined at the time of preparation of this program-level EIR. Project-specific impacts would be addressed in project-specific environmental studies conducted by the lead agency at the time the projects are proposed for approval.

This program-level document qualitatively assesses the potential impacts on flood management resulting from implementation of the Proposed Project and alternatives in terms of how project components could affect flood risk in the Delta and flood management facilities or programs as a result of project implementation. Potential flood management impacts were evaluated based on how the different aspects of the Proposed Project and alternatives could affect Delta flood management and the increased risk of flooding based upon increased probability of flood events and increased consequences to land uses, ecosystem, communities, transportation, utilities, and other resources. The potential increases in flood flows, elevations, and velocities that could be caused by the implementation of projects encouraged by the Proposed Project and the alternatives were assessed qualitatively by applying general principles of hydrology and hydraulics to a range of representative conditions in California during the period of analysis. Potential increases in flood risk associated with climate change and sea level rise are discussed in Section 21, Climate Change and Greenhouse Gas Emissions.

The assessment of potential changes in flood management facilities encouraged by the Proposed Project (such as floodway and floodplain protection from development, construction of setback levees, increased level of flood protection for major developments in rural areas of the Delta, and reoperation of upstream reservoirs) included primarily evaluating decreases in short- and long-term Delta levee integrity. The assessment was qualitative based on the application of general principles of geotechnical engineering to a range of representative conditions in California during the period of analysis. Several factors affecting levee integrity were considered, including how changes in stage, flow velocities, wave erosion, scour and sediment deposition, and potential subsidence of land below or next to levees could lead to a change in channel or levee geometry that could, in turn, affect seepage, stability, and settlement conditions and a potential reduction in seismic resistance of levees. Increases in the necessary times to evacuate people or to protect structures can increase the consequences of flooding. These increases were assessed qualitatively.

This EIR proposes mitigation measures for increased flood risk and for adverse impacts to flood management in the Delta. The ability of these measures to reduce these potential impacts to less-than-significant levels also depends upon project-specific environmental studies; enforceability of these measures depends upon whether the project being proposed is a covered action or not. This is discussed in more detail in Section 5.4.3.6 and in Section 2B, Introduction to Resource Sections.

5.4.2 Thresholds of Significance

Based on Appendix G of the California Environmental Quality Act (CEQA) Guidelines, an impact related to flood management resources is considered significant if the proposed project would do any of the following:

- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or offsite
- Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems
- Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or FIRM or other flood hazard delineation map
- Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam
- Place within a 100-year flood hazard area structures which would impede or redirect flood flows, or inundation by seiche, tsunami, or mudflow

The following discussion of environmental impacts is limited to those potential impacts that could result in some level of significant environmental change as defined by CEQA. As individual activities are proposed by other agencies, these individual projects will need to be evaluated in site-specific environmental documents prepared by the lead agencies.

5.4.3 Proposed Project

5.4.3.1 Reliable Water Supply

As described in Sections 2A, Proposed Project and Alternatives, and 2B, Introduction to Resource Sections, the Delta Plan does not direct the construction of specific projects, nor would projects be implemented under the direct authority of the Council. However, the Delta Plan seeks to improve water supply reliability by encouraging various actions, which if taken could lead to completion, construction and/or operation of projects that could provide a more reliable water supply. Such projects and their features could include the following:

- Surface water projects (water intakes, treatment and conveyance facilities, reservoirs, hydroelectric facilities)
- Groundwater projects (wells, wellhead treatment, conveyance facilities)
- Ocean desalination projects (water intakes, brine outfalls, treatment and conveyance facilities)
- Recycled wastewater and stormwater projects (treatment and conveyance facilities)
- Water transfers
- Water use efficiency and conservation program implementation

The number and location of all potential projects that would be implemented is not known at this time. However, the Proposed Project specifically names the DWR Surface Water Storage Investigation, which includes the North-of-the-Delta Offstream Storage Investigation (Sites Reservoir), Los Vaqueros Reservoir Project (Phase 2), and the Upper San Joaquin River Basin Storage Investigation Plan (Temperance Flat Reservoir). It also encourages the update of Bulletin 118.

5.4.3.1.1 Impact 5-1a: Substantially Alter the Existing Drainage Pattern of the Site or Area, Including Through the Alteration of the Course of a Stream or River, or Substantially Increase the Rate or Amount of Surface Runoff in a Manner Which Would Result in Flooding On- or Offsite

Effects of Project Construction

Construction of facilities associated with surface water and groundwater projects (including those that could be encouraged through the update of Bulletin 118) and recycled wastewater and stormwater projects, and modification of water supply flows through the Delta could substantially alter drainage patterns and create or increase offsite flooding. Actual alterations of drainage patterns would depend on the type of construction activity and hydrologic and hydraulic factors. Land grading, placing of dredged material, constructing structures and earthen enbankments, and stockpiling construction materials could create physical barriers to flowing stormwater runoff (drainage). These barriers could increase flood flow water surface elevations on- and offsite and could redirect flood flows to sites adjacent to the construction site. In addition, these activities could change the onsite land slopes across which drainage flows, which could increase the flow rates, directions, elevations, or velocities of drainage that enters and/or originates on the construction site. Activities such as paving, vegetation removal, or soil compacting would increase land surface imperviousness (inability to be penetrated by water) and decrease precipitation losses to soil infiltration, which would result in increases in onsite drainage flow rates, water surface elevations, and velocities. These impacts have the potential to occur at any construction site, as stormwater runoff occurs on all land surfaces. These impacts could be temporary and limited to the construction phase.

It is unclear at this time how implementation of the Proposed Project would result in specific construction activities, including the location, number, capacity, and methods and duration of construction activities. However, the Delta Plan encourages at least to some degree implementation of the North-of-the-Delta Offstream Storage Investigation, Los Vaqueros Reservoir Project (Phase 2), and the Upper San Joaquin River Basin Storage Investigation Plan. These are possible new or expanded surface water storage facilities.

Of the three large surface storage reservoirs considered by the DWR Surface Water Storage Investigation, only the Los Vaqueros Reservoir Expansion Project has been studied in an EIS/EIR; the other two projects have not. The Los Vaqueros EIS/EIR provides specific information on the impacts of that project; however, it also provides analogous information about the types of impacts expected from construction and operation of these two other projects, which are similar. In addition, the project-specific

EIR for another surface storage project (not named in the Delta Plan)—the Calaveras Dam Replacement Project—also provides analogous information. See Section 2B, Introduction to Resource Sections, for more discussion of the projects and environmental documents that were reviewed in the preparation of this draft EIR.

The Los Vaqueros Reservoir Expansion EIS/EIR (Reclamation et al. 2009) evaluated several alternatives to increase water storage, a new Delta intake structure, and conveyance facilities. The lead agency found that project alternatives would not substantially alter drainage patterns but reservoir expansion would increase the reservoir shoreline area subject to erosion. This impact was considered less than significant, and no mitigation would be required.

In the EIR prepared for the Calaveras Dam Replacement project (SFPUC 2011), the San Francisco Public Utilities Commission (SFPUC) found that although the project would change flows downstream of the project, these changes in flows would be less than significant.

Construction activities of surface water, groundwater, recycled wastewater, and stormwater projects, generally would have similar impacts on flood management. Although not named in the Delta Plan, the following projects based upon a review of their project-specific EIRs are illustrative of the types of impacts associated with some of these other projects: the Davis-Woodland Water Supply Project (City of Davis et al. 2007), which includes a water intake in the Sacramento River, pumping plants, and conveyance and water treatment facilities; and the Huntington Beach Seawater Desalination Project (City of Huntington Beach 2005) which illustrates some the likely impacts of seawater desalination plants.

In the EIR for the Davis-Woodland Water Supply Project (City of Davis et al. 2007), the City found that the project would substantially alter the existing drainage pattern, and in turn would increase local storm runoff that would exceed the capacity of onsite drainage systems, or create localized flooding or contribute to a cumulative flooding impact downstream. This impact was significant, but was identified as less than significant with mitigation through preparation and implementation of a drainage plan that includes measures to infiltrate, retain, or otherwise channel runoff away from areas of open soil and other features subject to erosion or flooding. Runoff water would be discharged in a manner that would prevent increases in downstream or offsite flooding.

The City of Huntington Beach found that the proposed desalination facility could have hydrology and water quality impacts in regards to flooding and stormwater runoff. These impacts were identified as less than significant with mitigation by performing appropriate hydrology and hydraulic analysis and incorporating mitigation measures as necessary for stormwater drainage and flooding.

Effects of Project Operation

Modification of water supply flows through the Delta could result in upstream reservoir operation changes. These changes could change the timing and duration of downstream flows during flood and non-flood periods. Because there is an obligation that these reservoirs maintain a certain amount of flood control space, it is not likely that the peak flood flow releases would increase. However, it is possible, although not probable, that flood releases, with changed timing or duration, from the water storage projects could combine with flood flows from downstream tributary rivers in such a way that the overall downstream flood flow increases relative to the existing environment. This potential impact would most likely occur in rivers downstream of confluences of major rivers that have upstream reservoirs, such as downstream of the confluence of the Sacramento and American rivers, which could impact the cities of West Sacramento and Sacramento, among others.

Other programs intended to improve water supply reliability, such as water conservation or water transfers, could result in more water remaining in the rivers and reservoirs tributary to the Delta and less water being removed from the Delta. This could have a similar effect on overall downstream flood flows.

Conclusion

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies, and these analyses will include more information on impacts resulting from climate change. During the project-level analyses, these impacts will be identified by drainage or hydrology and hydraulic studies, as they depend on various site-specific factors and on the proximity of the construction site to people, structures, and transportation routes. These types of impacts are likely to be most evident in areas prone to flooding, such as those identified on FEMA FIRMs, where tall and long features, such as canal embankments, are constructed across the floodplain flow path. However, because water supply reliability projects encouraged by the Delta Plan could result in changes to drainage patterns that could cause flooding, the potential impacts are considered **significant**.

5.4.3.1.2 Impact 5-2a: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Effects of Project Construction

Any of the water supply reliability projects or features listed in Section 5.4.3.1 could include construction activities that could substantially create or contribute stormwater runoff water to existing or planned stormwater drainage systems and could exceed the capacities of those systems. Activities such as paving, vegetation removal, or soil compacting would increase land surface imperviousness (inability to be penetrated by water) and decrease precipitation losses to soil infiltration, which would result in increases in onsite drainage flow rates, water surface elevations, and velocities. Actual alterations of drainage patterns would depend on the type of construction activity and hydrologic and hydraulic factors. These changes could occur at any construction site, but would likely only have relatively localized effects onsite and immediately downstream, or downslope of the site. The changes in runoff could persist at any of the facilities that have permanent changes in land cover such as increases in paved or compacted surfaces or that have vegetation that is removed.

It is unclear at this time how implementation of the Proposed Project would result in all construction activities, including the location, number, capacity, and methods and duration of construction activities. However, the Delta Plan encourages implementation of the following surface storage projects: North-of-the-Delta Offstream Storage Investigation, Los Vaqueros Reservoir Project, and the Upper San Joaquin River Basin Storage Investigation Plan.

In the Los Vaqueros Reservoir Expansion EIS/EIR (Reclamation et al. 2009), the lead agency found that project alternatives could create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff during construction. However, by designing facilities with introduced impervious surfaces with stormwater control measures that are consistent with the Regional Water Quality Control Board's National Pollutant Discharge Elimination Sysytem municipal stormwater runoff requirements and implementing a Stormwater Facility Operation and Management Plan, this impact would be mitigated to a less-than-significant level.

The San Francisco Public Utilities Commission (SFPUC) found that the Calaveras Dam Replacement project (SFPUC 2011) would not involve existing stormwater drainage systems. It was determined that it was not necessary to evaluate this potential impact.

Additional documents reviewed for potential impacts included EIRs for the Davis-Woodland Water Supply Project EIR (City of Davis et al. 2007), which includes a water intake in the Sacramento River, pumping plants, and conveyance and water treatment facilities, and the Huntington Beach Seawater Desalination Project EIR (City of Huntington Beach 2005), which illustrates some the likely impacts of seawater desalination plants.

In the EIR for the Davis-Woodland Water Supply Project (City of Davis et al. 2007), the City found that the project would create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff. This impact was significant, but could be mitigated to a less-than-significant level by implementing a Storm Water Pollution Prevention Plan (SWPPP) for all construction phases of the project. The SWPPP would identify pollutant sources that may affect the quality of stormwater discharge and shall require the implementation of best management practices (BMPs) to reduce pollutants in stormwater discharges.

The City of Huntington Beach found that the proposed desalination facility could have hydrology and water quality impacts in regard to flooding and stormwater runoff during construction only. These impacts could be mitigated to less-than-significant levels by installing an appropriate onsite drainage system that integrates permanent stormwater quality features.

Effects of Project Operation

Any of the water supply reliability projects or features listed in Section 5.4.3.1 could include construction of facilities that could substantially create or contribute stormwater runoff water to existing or planned stormwater drainage systems and could exceed the capacities of those systems, as described above. These changes could change drainage patterns following construction. Actual alterations of drainage patterns would depend on the facilities and hydrologic and hydraulic factors. These changes could occur at any facility, but would likely only have relatively localized effects on site and immediately downstream, or downslope of the site.

It is unclear at this time how implementation of the Proposed Project would result in new facilities, including the location and number of facilities. However, as described above, the Delta Plan encourages implementation of the following surface storage projects: North-of-the-Delta Offstream Storage Investigation, Los Vaqueros Reservoir Project, and the Upper San Joaquin River Basin Storage Investigation Plan.

In the Los Vaqueros Reservoir Expansion EIS/EIR (Reclamation et al. 2009), the lead agency found that project alternatives could create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff during operation. However, by designing facilities with introduced impervious surfaces with stormwater control measures that are consistent with the Regional Water Quality Control Board’s National Pollutant Discharge Elimination System municipal stormwater runoff requirements and implementing a Stormwater Facility Operation and Management Plan, this impact would be mitigated to a less-than-significant level.

Another document reviewed for potential impacts was the EIR for the Davis-Woodland Water Supply Project EIR (City of Davis et al. 2007), which includes a water intake in the Sacramento River, pumping plants, and conveyance and water treatment facilities. In this EIR, the City found that the project would create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff. This impact was significant, but could be mitigated to a less-than-significant level by implementing a SWPPP for all construction phases of the project. The SWPPP would identify pollutant sources that may affect the quality of stormwater discharge and shall require the implementation of BMPs to reduce pollutants in stormwater discharges.

Conclusion

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies, and these analyses will include more information on impacts resulting from climate change. During the project-level analyses, these impacts will be identified by drainage or hydrology and hydraulic studies, as they depend on various site-specific factors and on the proximity of the construction site to people, structures, and transportation routes. However, because water supply reliability projects encouraged by the Delta Plan could result in changes to runoff that could exceed the capacity of existing stormwater drainage systems, the potential impacts are considered **significant**.

5.4.3.1.3 Impact 5-3a: Place Housing Within a 100-year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map

The Delta Plan has been developed to encourage water storage and conveyance alternatives, among other water-related use improvement activities, and does not encourage projects promoting placement of additional housing within the Delta. Therefore, the Delta Plan will have **no impact** related to housing placement within the 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or FIRM or other flood hazard delineation map.

5.4.3.1.4 Impact 5-4a: Expose People or Structures to a Significant Risk of Loss, Injury or Death Involving Flooding, Including Flooding as a Result of the Failure of a Levee or Dam

Effects of Project Construction

Any of the water supply reliability projects or features listed in Section 5.4.3.1 could involve land grading, excavating, constructing large embankments, placing of dredged materials, installing coffer dams, constructing structures, dewatering, and stockpiling. These construction activities could modify the flood channel geometry, extract or add water to the flood channel, and/or impede flows. These changes, as a result of a construction project, could increase flood flow rates, water surface elevations, and velocities such that these changes could result in increased risk of levee overtopping, levee crown erosion, increases in seepage, decreases in waterside levee slope stability, increases in settlement and/or subsidence of, or adjacent to, levees, or a reduction in seismic resistance of levees. Alternatively, decreases in water surface elevations could lead to decreases in waterside levee slope stability and lead to positive impacts, such as decreases in seepage and increases in seismic resistance of levees. Groundwater dewatering during construction could also lead to increases in subsidence below or adjacent to existing levees. As a results of these increases or reductions, short-term levee integrity would be decreased, and the risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee, would be increased. The changes in levee integrity could persist at any of the facilities that have changes during construction.

Increases in flood risk from levee failure could expose people and structures in the vicinity of the construction to potential decreases in available evacuation times and potential increases in emergency response times. If levees do fail and flood flows progress across floodplains, structures and embankments (associated with the projects above) constructed in the floodplain could impede or modify the direction of flood flows and cause portions of floodplains to fill faster. Again, faster filling times would give people even less time to evacuate and could also result in key emergency response routes being flooded more quickly, causing increases in emergency response times.

Construction of new surface water storage project facilities (such as those considered under DWR’s Surface Water Storage Investigation) would involve impounding large volumes of water. Failure of these facilities could result in sudden, catastrophic flooding downstream of those storage facilities.

The Los Vaqueros Reservoir Expansion EIS/EIR (Reclamation et al. 2009) evaluated the construction of a new setback levee built to increase water storage capacity (dam embankment raise). The lead agency found that modern dam impoundments are designed and constructed under conservative guidelines and criteria designed to prevent dam and levee failure. Such modern design criteria and construction practices are also combined with California Department of Safety of Dams review, as well as input and approval from the local reclamation district. The lead agency determined that the probability of dam and levee failure is extremely small, and the potential impacts from failure would be less than significant.

In the EIR prepared for the Calaveras Dam Replacement project (SFPUC 2011), the SFPUC found that although construction of the replacement dam would temporarily increase downstream flooding risk, impacts associated with downstream flooding and hazard in the event of dam failure would be less than significant.

In the EIR for the Davis-Woodland Water Supply Project (City of Davis et al. 2007), the City found that the project construction could expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee. This impact was significant, but could be mitigated to a less-than-significant level by ensuring that all construction activities abide by applicable reclamation district guidelines for levee disturbance.

Effects of Project Operation

Operation of new surface water storage project facilities (such as those considered under DWR's Surface Water Storage Investigation, as described above) could result in sudden, catastrophic flooding downstream of those storage facilities. Operation of water supply reliability projects also could expose people and structures in the vicinity or downstream of the facilities to new flooding sources (for example, water supply canals).

The Los Vaqueros Reservoir Expansion EIS/EIR (Reclamation et al. 2009) evaluated the long-term operation of a new setback levee built to increase water storage capacity (dam embankment raise). The lead agency found that modern dam impoundments are designed and constructed under conservative guidelines and criteria designed to prevent dam and levee failure. Such modern design criteria and construction practices are also combined with California Department of Safety of Dams review, as well as input and approval from the local reclamation district. The lead agency determined that the probability of dam and levee failure is extremely small, and the potential impacts from failure would be less than significant.

In the EIR for the Davis-Woodland Water Supply Project (City of Davis et al. 2007), the City found that the project operation could expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee. This impact was significant, but could be mitigated to a less-than-significant level by ensuring that all construction activities abide by applicable reclamation district guidelines for levee disturbance.

Conclusion

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies, and these analyses will include more information on impacts resulting from climate change. During the project-level analyses, the levee integrity and similar impacts will be identified based on geotechnical studies and on drainage or hydrology and hydraulic studies. However, because water supply reliability projects encouraged by the Delta Plan could adversely affect levee integrity, as well as the integrity of other water conveyance and storage facilities, and have adverse effects on evacuation and emergency response times, the potential impacts are considered **significant**.

5.4.3.1.5 Impact 5-5a: Place Within a 100-year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Inundation by Seiche, Tsunami, or Mudflow

Effects of Project Construction

The Delta Plan encourages projects that would include the construction of surface water and groundwater storage facilities, water intakes, conveyance facilities (canals, pipelines, tunnels, siphons, and pumping plants), groundwater wells, water transfers, and hydroelectric generation. Activities during construction of these facilities could include land grading, placing of dredged material, constructing structures and earthen enbankments, and stockpiling construction materials. All of these activities could create physical barriers to flowing stormwater runoff (drainage) and flood flows. These barriers could increase flood flow water surface elevations on- and off site and could redirect flood flows to sites adjacent to the construction site. These changes could occur at any construction site, as rainfall runoff occurs on all land surfaces, and could, depending on various factors, lead to flooding. The impacts could be temporary and limited to the construction phase. Actual redirection and impedance of flood flows would depend on the type of construction activity and hydrologic and hydraulic factors. These types of impacts are likely to be most evident where tall and long features, such as canal embankments, are constructed across the floodplain flow path.

In the Los Vaqueros Reservoir Expansion EIS/EIR (Reclamation et al. 2009), the lead agency evaluated whether project alternatives could place structures within a 100-year flood hazard area, which could impede or redirect flood flows. The lead agency found that this impact would be less than significant and no mitigation would be required.

Other documents reviewed for potential impacts included the EIR for the Davis-Woodland Water Supply Project (City of Davis et al. 2007), which includes a water intake in the Sacramento River, pumping plants, and conveyance and water treatment facilities, and the Carlsbad Precise Development Plan and Desalination Plant Project EIR (City of Carlsbad 2005), which is an example of some the likely impacts of seawater desalination plants. The City of Davis found that the project would place within a 100-year flood hazard area structures that would impede or redirect flood flows. This impact was significant, but could be mitigated to a less-than-significant level by incorporating a design to minimize changes to flood flow elevation and accumulation of floating debris. The City of Carlsbad found that during construction, placement of construction materials could temporarily impede or redirect flows. This significant impact could be mitigated to a less-than-significant level by scheduling construction during dry months (May 1 to September 30) and implementation of a SWPPP.

Effects of Project Operation

The Delta Plan encourages projects that would include operation of surface water and groundwater storage facilities, water intakes, conveyance facilities (canals, pipelines, tunnels, siphons, and pumping plants), groundwater wells, water transfers, and hydroelectric generation, as described above. All of these activities could create physical barriers to flowing stormwater runoff (drainage) and flood flows. These barriers could increase flood flow water surface elevations on- and off site and could redirect flood flows to sites adjacent to the construction site. The impacts could persist through operation of the project. These types of impacts are likely to be most evident where tall and long features, such as canal embankments, are constructed across the floodplain flow path.

The EIR for the Davis-Woodland Water Supply Project (City of Davis et al. 2007), which includes a water intake in the Sacramento River, pumping plants, and conveyance and water treatment facilities. The City of Davis found that the project would place within a 100-year flood hazard area structures that would impede or redirect flood flows. This impact was significant, but could be mitigated to a less-than-significant level by incorporating a design to minimize changes to flood flow elevation and accumulation of floating debris.

Conclusion

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies, and these analyses will include more information on impacts resulting from climate change. During the project-level analyses, these impacts will be identified by drainage or hydrology and hydraulic studies, as they depend on various site-specific hydrologic and hydraulic factors. However, because water supply reliability projects encouraged by the Delta Plan could result in flood flow impedances that could cause flooding, the potential impacts are considered **significant**.

5.4.3.2 Delta Ecosystem Restoration

As described in Sections 2A, Proposed Project and Alternatives, and 2B, Introduction to Resource Sections, the Delta Plan does not direct the construction of specific projects, nor would projects be implemented under the direct authority of the Council. However, the Delta Plan seeks to improve the Delta ecosystem by encouraging various actions and projects, which if taken could lead to completion, construction and/or operation of projects that could improve the Delta ecosystem.

Features of such projects and actions that could be implemented as part of efforts to restore the Delta ecosystem include the following:

- Floodplain restoration
- Riparian restoration
- Tidal marsh restoration
- Stressor management
- Invasive species management (including removal of invasive vegetation)

The number and location of all potential projects that could be implemented is not known at this time. Five projects or project locations, however, are known to various degrees and are named in the Delta Plan:

- Cache Slough Complex (includes Prospect Island Restoration Project)
- Cosumnes River–Mokelumne River Confluence: North Delta Flood Control and Ecosystem Restoration Project
- Lower San Joaquin River Bypass Proposal
- Suisun Marsh Habitat Management, Preservation, and Restoration Plan (includes Hill Slough Restoration Project)
- Yolo Bypass

Of these five, only the Suisun Marsh project and the North Delta Flood Control and Ecosystem Restoration Project have been the subject of project-specific environmental documents (Suisun Marsh Habitat Management, Preservation, and Restoration Plan Draft EIS/EIR [Reclamation et al. 2010] and North Delta Flood Control and Ecosystem Restoration Project [DWR 2010e]).

In addition to these projects, the policies and recommendations of the Proposed Project could influence several named programs that could result in environmental impacts. These include the Water Quality Control Plan Update for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (water flow objectives update), the Delta Conservancy Strategic Plan, the variance for USACE Vegetation Policy, and DFG’s Stage Two Actions for Nonnative Invasive Species.

5.4.3.2.1 Impact 5-1b: Substantially Alter the Existing Drainage Pattern of the Site or Area, Including Through the Alteration of the Course of a Stream or River, or Substantially Increase the Rate or Amount of Surface Runoff in a Manner Which Would Result in Flooding On- or Off Site

Effects of Project Construction

Any of the ecosystem restoration projects or features listed in Section 5.4.3.2 could include construction activities such as topographic grading, removing or relocating levee sections, exposing bare soil, placing dredged material, constructing structures and earthen enbankments, stockpiling construction materials, and changing vegetation that could substantially alter drainage patterns and create or increase on- and offsite flooding. The potential impacts to existing drainage patterns would generally be similar to those described for water supply reliability projects in Section 5.4.3.1.1. These impacts have the potential to occur at any construction site, as stormwater runoff occurs on all land surfaces. Actual alteration of drainage patterns would depend on the type of the construction activity and local hydrologic and hydraulic factors. They could be temporary and limited to the construction phase.

Setting back or relocating levees could be included with any environmental restoration project. Moving a levee further into a floodplain could remove some water storage space from the floodplain. Additionally, flooding from other sources (besides the stream on which the setback lies) could cause ponding along the land side of the new setback levee rather than against the original levee. Other conditions could then cause this ponding to be shifted away from the (landside of the) new levee, resulting in the flooding of new areas that were not previously at risk of flooding. This flooding could occur anywhere setbacks are constructed where the floodplain slopes down toward the existing and (replacement) setback levees.

It is not known at this time exactly what types or where construction of specific restoration projects that could alter drainage patterns. However, the Delta Plan encourages and/or mentions implementation of the projects listed in Section 5.4.3.2. There are ongoing projects that are similar to these restoration projects, the environmental evaluation of which would be comparable to some of the actions/activities that would be expected with the encouraged projects. These ongoing projects include the Suisun Marsh Habitat Management, Preservation, and Restoration Plan (a project named in the Delta Plan) and the North Delta Flood Control and Ecosystem Restoration Project.

The Suisun Marsh Management, Preservation, and Restoration Plan EIS/EIR (Reclamation et al. 2010) evaluated three alternatives to restore marsh habitat and create managed wetlands in Suisun Marsh. The lead agency found that opening tidal restoration areas to flood flows would decrease flood stage and flow capacity in adjacent Suisun Marsh channels, which would provide flood control benefits.

As described in the final EIR for the project (DWR 2010e), the North Delta Flood Control and Ecosystem Restoration Project would include opening the McCormack-Williamson Tract to tidal action. The design of the project included levee improvements to accommodate some slight drainage pattern changes. In the EIR prepared for this project, DWR found the drainage pattern and flooding impacts to be less than significant.

Effects of Project Operation

Operations of any of the ecosystem restoration projects or features listed in Section 5.4.3.2 following construction activities described above could substantially alter drainage patterns and create or increase on- and offsite flooding. The potential impacts to existing drainage patterns would generally be similar to those described for water supply reliability projects in Section 5.4.3.1.1. The impacts could persist through operation of the project. Some impacts could occur only during operation of projects, such as the flooding of a wetlands restoration area, after construction.

It is not known at this time exactly what types or where construction of specific restoration projects that could alter drainage patterns. However, the Delta Plan encourages and/or mentions implementation of the projects listed in Section 5.4.3.2. There are ongoing projects that are similar to these restoration projects, the environmental evaluation of which would be comparable to some of the actions/activities that would be expected with the encouraged projects. These ongoing projects include the Suisun Marsh Habitat Management, Preservation, and Restoration Plan (a project named in the Delta Plan), and the North Delta Flood Control and Ecosystem Restoration Project.

The Suisun Marsh Management, Preservation, and Restoration Plan EIS/EIR (Reclamation et al. 2010) evaluated three alternatives to restore marsh habitat and create managed wetlands in Suisun Marsh. The lead agency found that opening tidal restoration areas to flood flows would decrease flood stage and flow capacity in adjacent Suisun Marsh channels, which would provide flood control benefits.

As described in the final EIR for the project (DWR 2010e), the North Delta Flood Control and Ecosystem Restoration Project would include opening the McCormack-Williamson Tract to tidal action. The design of the project included levee improvements to accommodate some slight drainage pattern changes. In the EIR prepared for this project, DWR found the drainage pattern and flooding impacts to be less than significant.

Conclusion

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies, and these analyses will include more information on impacts resulting from climate change. During the project-level analyses, these impacts will be identified by drainage or hydrology and hydraulic studies, as they depend on various site-specific factors and on the proximity of the construction site to people, structures, and transportation routes. These types of impacts are likely to be most evident in areas prone to flooding, such as those identified on FEMA FIRMs, where tall and long features, such as setback levees, are constructed across the floodplain flow path. However, because ecosystem restoration projects encouraged by the Delta Plan could result in changes to drainage patterns that could cause flooding, the potential impacts are considered **significant**.

5.4.3.2.2 Impact 5-2b: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Projects encouraged by the Delta Plan would include the construction of Delta ecosystem restoration areas, including floodplain, riparian, and wetland restoration areas, along with management of stressors and invasive species, and modification of levees and associated infrastructure. These facilities would not likely drain into existing or planned stormwater drainage systems, and there would be **no impact**.

5.4.3.2.3 Impact 5-3b: Place Housing Within a 100-year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map

Projects encouraged by the Delta Plan would include the construction of Delta ecosystem restoration areas, including floodplain, riparian, and wetland restoration areas, along with management of stressors and invasive species, and modification of levees and associated infrastructure. These actions would not include placement of new housing within a 100-year flood hazard area, and there would be **no impact**.

5.4.3.2.4 Impact 5-4b: Expose People or Structures to a Significant Risk of Loss, Injury or Death Involving Flooding, Including Flooding as a Result of the Failure of a Levee or Dam

Effects of Project Construction

Any of the ecosystem restoration projects or features listed in Section 5.4.3.2 could involve land grading, excavating, constructing large embankments, placing dredged materials, installing coffer dams, constructing structures, dewatering, and stockpiling. Potential impacts would be to existing levee integrity and evacuation and emergency response times, and would generally be similar to those described for water supply reliability projects in Section 5.4.3.1.4. In addition, longer channel wind fetch lengths could result from construction of new setback levees or levee breaches made for opening restoration areas to flooding. Longer fetch lengths could result in additional wave erosion and increased water surface elevations on the water side of channel levees, decreasing levee integrity. Similarly, interior levees would be exposed to tidal action, which could result in erosion of the interior levees and result in higher water surface elevations on the levees. The changes in levee integrity could persist at any of the facilities that have changes during construction.

In the Suisun Marsh Management, Preservation, and Restoration Plan EIS/EIR (Reclamation et al. 2010), the lead agency found that impacts associated with catastrophic levee failure and flooding resulting from restoration activities that expose interior levees to tidal action would be less than significant. A reduction in the potential for catastrophic levee failure and flooding resulting from improvements in exterior levee maintenance would be beneficial.

In the North Delta Flood Control and Ecosystem Restoration Project EIR (DWR 2010e), DWR found all but one of the flood control and levee stability impacts to be less than significant. One potential impact, increased seepage, was determined to be significant. However, DWR found it could be reduced to less than significant through development of a seepage monitoring program.

Effects of Project Operation

Any of the ecosystem restoration projects or features listed in Section 5.4.3.2 could involve construction as described above. Potential operational impacts would be to existing levee integrity and evacuation and emergency response times, and would generally be similar to those described for water supply reliability projects in Section 5.4.3.1.4. In addition, longer channel wind fetch lengths could result from construction of new setback levees or levee breaches made for opening restoration areas to flooding, as described above.

In the Suisun Marsh Management, Preservation, and Restoration Plan EIS/EIR (Reclamation et al. 2010), the lead agency found that impacts associated with catastrophic levee failure and flooding resulting from restoration activities that expose interior levees to tidal action would be less than significant. A reduction in the potential for catastrophic levee failure and flooding resulting from improvements in exterior levee maintenance would be beneficial.

In the North Delta Flood Control and Ecosystem Restoration Project EIR (DWR 2010e), DWR found all but one of the flood control and levee stability impacts to be less than significant. One potential impact, increased seepage, was determined to be significant. However, DWR found it could be reduced to less than significant through development of a seepage monitoring program.

Conclusion

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies, and these analyses will include more information on impacts resulting from climate change. During the project-level analyses, the levee integrity and similar impacts, such as evacuation and emergency response impacts will be identified based on geotechnical studies and on drainage or hydrology and hydraulic studies, because they depend on various site-specific hydrologic and hydraulic factors, geotechnical factors, and on the proximity of the project site to levees and other flood risk reduction facilities. However, because water supply reliability projects encouraged by the Delta Plan could adversely affect levee integrity, as well as the integrity of other water conveyance and storage facilities, and have adverse effects on evacuation and emergency response times, the potential impacts are considered **significant**.

5.4.3.2.5 Impact 5-5b: Place Within a 100-year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Inundation by Seiche, Tsunami, or Mudflow

Effects of Project Construction

Projects encouraged by the Delta Plan include the construction of Delta ecosystem restoration areas, including floodplain, riparian, and wetland restoration areas, along with management of stressors and invasive species, and modification of levees and associated infrastructure. Any of these project facilities could include construction activities such as topographic grading, removing or relocating levee sections, placing dredged material, constructing structures and earthen enbankments, and stockpiling construction materials that could substantially impede or redirect flood flows. The potential impacts to flood flow would generally be similar to those described for water supply reliability projects in Section 5.4.3.1.5. These impacts could occur at any construction site, as stormwater runoff occurs on all land surfaces. Actual alteration of flood flows would depend on the type of construction activity and local hydrologic and hydraulic factors. However, these types of impacts are likely to be most evident where tall and long features, such as setback levees, are constructed across the floodplain flow path. Impacts could be temporary and limited to the construction phase.

Setting back or relocating levees could be included with any ecosystem restoration project. Moving a levee further into a floodplain could remove some water storage space from the floodplain. Additionally, flooding from other sources (besides the stream on which the setback lies) could cause ponding along the land side of the new setback levee rather than against the original levee. Other conditions could then cause this ponding to be shifted away from the landside of the new levee, resulting in the flooding of new areas that were not previously at risk of flooding. This flooding could occur anywhere setbacks are constructed where the floodplain slopes down toward the existing and (replacement) setback levees.

In the Suisun Marsh Management, Preservation, and Restoration Plan EIS/EIR (Reclamation et al. 2010), the lead agency found that changes in flood stage and flow capacity in Suisun Marsh channels as a result of increased tidal prism and flood storage capacity would be beneficial. In the North Delta Flood Control and Ecosystem Restoration Project EIR (DWR 2010e), DWR found all but one of the flood control and levee stability impacts to be less than significant. One potential impact, increased seepage, was determined to be significant. However, DWR found it could be reduced to less than significant through development of a seepage monitoring program.

Effects of Project Operation

Projects encouraged by the Delta Plan include the operation of Delta ecosystem restoration areas, including floodplain, riparian, and wetland restoration areas, along with management of stressors and invasive species, and modification of levees and associated infrastructure. Any of these project facilities could include construction activities described above. The potential impacts to flood flow would generally be similar to those described for water supply reliability projects in Section 5.4.3.1.5. Actual alteration of flood flows would depend on the type of activity and local hydrologic and hydraulic factors. However, these types of impacts are likely to be most evident where tall and long features, such as setback levees, are constructed across the floodplain flow path. Impacts could persist through operation of the project, such as the flooding of a environmental restoration area after construction.

In the Suisun Marsh Management, Preservation, and Restoration Plan EIS/EIR (Reclamation et al. 2010), the lead agency found that changes in flood stage and flow capacity in Suisun Marsh channels as a result of increased tidal prism and flood storage capacity would be beneficial. In the North Delta Flood Control and Ecosystem Restoration Project EIR (DWR 2010e), DWR found all but one of the flood control and levee stability impacts to be less than significant. One potential impact, increased seepage, was determined to be significant. However, DWR found it could be reduced to less than significant through development of a seepage monitoring program.

Conclusion

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies, and these analyses will include more information on impacts resulting from climate change. During the project-level analyses, these impacts will be identified by drainage or hydrology and hydraulic studies, as they depend on various site-specific hydrologic and hydraulic factors. However, because ecosystem restoration projects encouraged by the Delta Plan could result in flood flow impedances that could cause flooding, the potential impacts are considered **significant**.

5.4.3.3 Water Quality Improvement

As described in Sections 2A, Proposed Project and Alternatives, and 2B, Introduction to Resource Sections, the Delta Plan does not direct the construction of specific projects, nor would projects be implemented under the direct authority of the Council. However, the Delta Plan seeks to improve water quality by encouraging various actions and projects that if taken could lead to completion, construction and/or operation of projects that could improve water quality.

Actions would include implementation of plans/programs that lead to reduced constituents from agricultural runoff and wastewater treatment plants.

Associated projects could include construction and operation and maintenance of facilities such as these:

- Water treatment plants
- Conveyance facilities (pipelines and pumping plants)
- Wastewater treatment and recycle facilities
- Municipal stormwater treatment facilities
- Agricultural runoff treatment (eliminate, capture and treat/reuse)
- Wellhead treatment facilities
- Wells (withdrawal, recharge, and monitoring)

The number and location of all potential actions and projects that could be implemented is currently not known. Various projects, however, are known to some degree and are named in the Delta Plan:

- Central Valley Drinking Water Policy
- Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS)
- Water Quality Control Plan Update for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (water flow objectives update)
- State Water Resources Control Board/Central Valley Regional Water Quality Control Board Strategic Workplan
- Completion of the following regulatory processes, research, and monitoring:
- Central Valley Pesticide Total Maximum Daily Load and Basin Plan Amendment for diazinon and chlorpyrifos

- Central Valley Pesticide Total Maximum Daily Load and Basin Plan Amendment for pyrethroids
- Total Maximum Daily Load and Basin Plan Amendments for selenium and methylmercury
- North Bay Aqueduct Alternative Intake Project

Of these named projects/actions, only the North Bay Aqueduct Project and the CV-SALTS effort would involve construction and/or operation of facilities that could have flood management impacts. Regulatory processes such as total maximum daily load development and basin plans, new policy documents, and updates to existing policies encouraged by the Delta Plan would not cause impacts to existing structures nor create new ones, so there are no anticipated impacts on flood risk from these processes and programs.

5.4.3.3.1 Impact 5-1c: Substantially Alter the Existing Drainage Pattern of the Site or Area, Including Through the Alteration of the Course of a Stream or River, or Substantially Increase the Rate or Amount of Surface Runoff in a Manner Which Would Result in Flooding On- or Offsite

Effects of Project Construction

The water quality improvement projects and actions listed in Section 5.4.3.3 could result in construction activities such as topographic grading, removing or relocating levee sections, exposing bare soil, placing dredged material, constructing structures and earthen enbankments, stockpiling construction materials, and changing vegetation for new or modified surface water treatment plant intakes/diversions or outfalls for wastewater treatment, stormwater treatment, or agricultural runoff treatment plants that could substantially alter drainage patterns and create or increase on- and offsite flooding. The potential impacts to existing drainage would be similar to those described for water supply reliability projects in Section 5.4.3.1.1. These impacts have the potential to occur at any construction site, as stormwater runoff occurs on all land surfaces. Actual alteration of drainage patterns would depend on the type of construction activity and local hydrologic and hydraulic factors. These impacts could be temporary and limited to the construction phase.

The Delta Plan encourages implementation of the North Bay Aqueduct Alternative Intake Project and the CV-SALTS effort. Both projects are currently under evaluation by State and local agencies, and no specific plans have been published. The new North Bay Alternative Intake Structure serves the purpose of meeting CV-SALTS and water discharge requirements. The new alternative intake structure would be located on the Sacramento River in a rural area of Sacramento or Yolo County and the new pipeline would extend from the new intake structure to the existing North Bay Regional Water Treatment Plant. The diversion/intake structure and water conveyance pipeline are similar to those associated with the Davis-Woodland Water Supply Project, which provides analogous information. CV-SALTS is a program to coordinate approaches to improve water quality on the San Joaquin River through management of upstream discharge of constituents from urban and agricultural areas, including wastewater treatment plants. The program could result in modifications to wastewater treatment plants and facilities to reduce or treat runoff from agricultural areas.

The Davis-Woodland Water Supply Project was discussed above in Section 5.4.3.1.1. The lead agency found that the project would substantially alter the existing drainage pattern, and in turn, would increase local storm runoff that would exceed the capacity of onsite drainage systems, or create localized flooding or contribute to a cumulative flooding impact downstream. This impact was significant, but could be mitigated to a less-than-significant level by preparation and implementation of a drainage plan that includes measures to infiltrate, retain, or otherwise channel runoff away from areas of open soil and other features subject to erosion or flooding. Runoff water would be discharged in a manner that would prevent downstream or offsite flooding.

Effects of Project Operations

The water quality improvement projects and actions listed in Section 5.4.3.3 could result in operation of facilities that included construction as described above that could substantially alter drainage patterns and create or increase on- and offsite flooding. The potential impacts to existing drainage would be similar to those described for water supply reliability projects in Section 5.4.3.1.1. Actual alteration of drainage patterns would depend on the type of activity and local hydrologic and hydraulic factors. These impacts could persist through operation of the project.

The Davis-Woodland Water Supply Project was discussed above in Section 5.4.3.1. The lead agency found that the project would substantially alter the existing drainage pattern, and in turn, would increase local storm runoff that would exceed the capacity of onsite drainage systems, or create localized flooding or contribute to a cumulative flooding impact downstream. This impact was significant, but could be mitigated to a less-than-significant level by preparation and implementation of a drainage plan that includes measures to infiltrate, retain, or otherwise channel runoff away from areas of open soil and other features subject to erosion or flooding. Runoff water would be discharged in a manner that would prevent downstream or offsite flooding.

Conclusion

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies, and these analyses will include more information on impacts resulting from climate change. During the project-level analyses, these impacts will be identified by drainage or hydrology and hydraulic studies, as they depend on various site-specific factors and on the proximity of the construction site to people, structures, and transportation routes. These types of impacts are likely to be most evident in areas prone to flooding, such as those identified on FEMA FIRMs, where tall and long features, such as canal embankments, are constructed across the floodplain flow path. However, because named projects and other projects encouraged by the Delta Plan could result in changes to drainage patterns that could cause flooding, the potential impacts are considered **significant**.

5.4.3.3.2 Impact 5-2c: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Effects of Project Construction

The water quality improvement projects and actions listed in Section 5.4.3.3 could result in construction activities that could substantially create or contribute stormwater runoff water to existing or planned stormwater drainage systems and could exceed the capacities of those systems. The potential impacts on existing drainage systems would be generally similar to those described for water supply reliability projects in Section 5.4.3.1.2. These impacts have the potential to occur at any construction site, as stormwater runoff occurs on all land surfaces. Actual creations or contributions of stormwater runoff would depend on the type of the construction activity and local hydrologic and hydraulic factors. These impacts could be temporary and limited to the construction phase.

It is unclear at this time how specific components of the Proposed Project would be constructed because the details of the project are not currently known, including the location, number, methods, and duration. There are ongoing projects that are similar to these water quality improvement projects, the environmental evaluation of which would be comparable to some of the actions/activities that would be expected with the encouraged projects. These ongoing projects include the Davis-Woodland Water Supply Project.

The Davis-Woodland Water Supply Project was discussed in Section 5.4.3.1. The lead agency found that the project would create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff. This impact was significant, but could be mitigated to a less-than-significant level by implementing a SWPPP for all construction phases of the project. The SWPPP would identify pollutant sources that may affect the quality of stormwater discharge and shall require the implementation of BMPs to reduce pollutants in stormwater discharges.

Effects of Project Operations

The water quality improvement projects and actions listed in Section 5.4.3.3 could include construction activities described above that could substantially create or contribute stormwater runoff water to existing or planned stormwater drainage systems and could exceed the capacities of those systems. The potential impacts on existing drainage systems would be generally similar to those described for water supply reliability projects in Section 5.4.3.1.2. These impacts could persist through operation of the project.

It is unclear at this time how specific components of improvements and actions encouraged by the Proposed Project would be constructed or operated because the details of the project are not currently known, including the location and number. There are ongoing projects that are similar to these water quality improvement projects, the environmental evaluation of which would be comparable to some of the actions/activities that would be expected with the encouraged projects. These ongoing projects include the Davis-Woodland Water Supply Project.

The Davis-Woodland Water Supply Project was discussed in Section 5.4.3.1. The lead agency found that the project would create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff. This impact was significant, but could be mitigated to a less-than-significant level by implementing a SWPPP for operations of the project. The SWPPP would identify pollutant sources that may affect the quality of stormwater discharge and shall require the implementation of BMPs to reduce pollutants in stormwater discharges.

Conclusion

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies, and these analyses will include more information on impacts resulting from climate change. During the project-level analyses, these impacts will be identified by drainage or hydrology and hydraulic studies, as they depend on various site-specific factors and on the proximity of the construction site to people, structures, and transportation routes. These types of impacts are likely to be most evident in areas prone to flooding, such as those identified on FEMA FIRMs, where tall and long features, such as canal embankments, are constructed across the floodplain flow path. However, because named projects and projects encouraged by the Delta Plan could result in changes to drainage patterns that could cause flooding, the potential impacts are considered **significant**.

5.4.3.3.3 Impact 5-3c: Place Housing Within a 100-year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map

Water quality improvement projects encouraged by the Delta Plan would include new and expanded treatment plants and conveyance facilities (water intakes, pipelines, canals, and pumping plants). These actions would not include placement of new housing within a 100-year flood hazard area, and there would be **no impact**.

5.4.3.3.4 Impact 5-4c: Expose People or Structures to a Significant Risk of Loss, Injury or Death Involving Flooding, Including Flooding as a Result of the Failure of a Levee or Dam

Effects of Project Construction

The water quality improvement projects and actions listed in Section 5.4.3.3 could result in construction activities that could involve land grading, excavating, constructing large embankments, placing dredged materials, installing coffer dams, constructing structures, dewatering, and stockpiling of construction materials for new or modified surface water treatment plant intakes/diversions or outfalls for wastewater treatment, stormwater treatment, or agricultural runoff treatment plants. Potential impacts would be to existing levee integrity and evacuation and emergency response times, and would be generally similar to those described above for water supply reliability projects in Section 5.4.3.1.4.

It is unclear at this time how specific components of the Proposed Project would be constructed because the details of the project are not currently known, including the location, number, methods, and duration. There are ongoing projects that are similar to these water quality improvement projects, the environmental evaluation of which would be comparable to some of the actions/activities that would be expected with the encouraged projects. These ongoing projects include the Davis-Woodland Water Supply Project.

The Davis-Woodland Water Supply Project was discussed in Section 5.4.3.1. The City found that the project construction could expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee. This impact was significant, but could be mitigated to a less-than-significant level by ensuring that all construction activities abide by applicable reclamation district guidelines for levee disturbance.

Effects of Project Operations

The water quality improvement projects and actions listed in Section 5.4.3.3 could result in construction activities as described above. Potential impacts would be to existing levee integrity and evacuation and emergency response times, and would be generally similar to those described above for water supply reliability projects in Section 5.4.3.1.4. These impacts could persist through operation of the project.

It is unclear at this time how specific components of improvements encouraged by the Proposed Project would be constructed or operated because the details of these projects are not currently known, including the location and number. There are ongoing projects that are similar to these water quality improvement projects, the environmental evaluation of which would be comparable to some of the actions/activities that would be expected with the encouraged projects. These ongoing projects include the Davis-Woodland Water Supply Project.

The Davis-Woodland Water Supply Project was discussed above in Section 5.4.3.1. The City found that the project operations could expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee. This impact was significant, but could be mitigated to a less-than-significant level by ensuring that all construction activities abide by applicable reclamation district guidelines for levee disturbance.

Conclusion

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies, and these analyses will include more information on impacts resulting from climate change. During the project-level analyses, the levee integrity and similar impacts will be identified based on geotechnical studies and on drainage or hydrology and hydraulic studies. However, because water supply reliability projects encouraged by the Delta Plan could adversely affect levee integrity, as well as the integrity of other water conveyance and storage facilities, and have adverse effects on evacuation and emergency response times, the potential impacts are considered **significant**.

5.4.3.3.5 Impact 5-5c: Place Within a 100-year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Inundation by Seiche, Tsunami, or Mudflow

Effects of Project Construction

The water quality projects listed in Section 5.4.3.3 could include construction activities in the waterways such as topographic grading, removing or relocating levee sections, placing dredged material, constructing structures and earthen enbankments, and stockpiling construction materials for new or modified surface water treatment plant intakes/diversions or outfalls for wastewater treatment, stormwater treatment, or agricultural runoff treatment plants that could substantially impede or redirect flood flows. The potential impacts to flood flows would be generally similar to those described for water supply reliability projects in Section 5.4.3.1.5. These impacts have the potential to occur at any construction site, as stormwater runoff occurs on all land surfaces. Actual alteration of flood flows would depend on the type of construction activity and local hydrologic and hydraulic factors. These impacts could be temporary and limited to the construction phase.

It is unclear at this time how specific components of the Proposed Project would be constructed because the details of the project are not currently known, including the location, number, methods, and duration. There are ongoing projects that are similar to these water quality improvement projects, the environmental evaluation of which would be comparable to some of the actions/activities that would be expected with the encouraged projects. These ongoing projects include the Davis-Woodland Water Supply Project.

The Davis-Woodland Water Supply Project was discussed above in section 5.4.3.1. The City of Davis found that the project would place within a 100-year flood hazard area structures that would impede or redirect flood flows. This impact was significant, but could be mitigated to a less-than-significant level by incorporating a design to minimize changes to flood flow elevation and accumulation of floating debris. The Carlsbad Precise Development Plan and Desalination Plant Project was also discussed above in Section 5.4.3.1. The City of Carlsbad found that during construction, placement of construction materials could temporarily impede or redirect flows. This significant impact could be mitigated to a less-than-significant level by scheduling construction during dry months (May 1 to September 30) and implementation of an SWPPP.

Effects of Project Operations

The water quality projects listed in Section 5.4.3.3 could include construction activities as described above that could substantially impede or redirect flood flows. The potential impacts to flood flows would be generally similar to those described for water supply reliability projects in Section 5.4.3.1.5. Actual alteration of flood flows would depend on the type of activity and local hydrologic and hydraulic factors. These impacts could persist through operation of the project, such as the flooding of a environmental restoration area after construction.

It is unclear at this time how specific components of the projects that may be encouraged by the Delta Plan would be constructed or operated because the details of these projects are not currently known, including the location and number. There are ongoing projects that are similar to these water quality improvement projects, the environmental evaluation of which would be comparable to some of the actions/activities that would be expected with the encouraged projects. These ongoing projects include the Davis-Woodland Water Supply Project.

The Davis-Woodland Water Supply Project was discussed above in Section 5.4.3.1 (Reliable Water Supply). The City of Davis found that the project would place within a 100-year flood hazard area structures which would impede or redirect flood flows. This impact was significant, but could be mitigated to a less-than-significant level by incorporating a design to minimize changes to flood flow elevation and accumulation of floating debris. The Carlsbad Precise Development Plan and Desalination Plant Project was also discussed above in Section 5.4.3.1.The City of Carlsbad found that during construction, placement of construction materials could temporarily impede or redirect flows. This significant impact could be mitigated to a less-than-significant level by scheduling construction during dry months (May 1 to September 30) and implementation of an SWPPP.

Conclusion

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies, and these analyses will include more information on impacts resulting from climate change. During the project-level analyses, these impacts will be identified by drainage or hydrology and hydraulic studies, as they depend on various site-specific factors and on the proximity of the construction site to people, structures, and transportation routes. These types of impacts are likely to be most evident where tall and long features, such as setback levees, are constructed across the floodplain flow path. However, because named projects and projects encouraged by the Delta Plan could result in changes to drainage patterns that could cause flooding, the potential impacts are considered **significant**.

5.4.3.4 Flood Risk Reduction

As described in Sections 2A, Proposed Project and Alternatives, and 2B, Introduction to Resource Sections, the Delta Plan does not direct the construction of specific projects, nor would projects be implemented under the direct authority of the Council. However, the Delta Plan seeks to reduce the risk of floods in the Delta by encouraging various actions, which if taken could lead to completion, construction and/or operation of projects that could reduce flood risks in the Delta. Such projects and their features could include the following:

- Setback levees
- Floodplain expansion
- Levee maintenance
- Levee modification
- Dredging
- Stockpiling of rock for flood emergencies
- Subsidence reversal
- Reservoir reoperation

The number and location of all potential projects that would be implemented is not known at this time. One possible project, however, is known to some degree and is named in the Delta Plan, specifically the Sacramento Deep Water Ship Channel and Stockton Deep Water Ship Channel Dredging (the United States Army Corps of Engineer's *Delta Dredged Sediment Long-Term Management Strategy* included in Appendix C, Attachment C-7 of this EIR). The Proposed Project also names DWR's A Framework for Department of Water Resources Investments in Delta Integrated Flood Management, which could, upon completion, provide guidance on the prioritization flood protection investments.

5.4.3.4.1 Impact 5-1d: Substantially Alter the Existing Drainage Pattern of the Site or Area, Including Through the Alteration of the Course of a Stream or River, or Substantially Increase the Rate or Amount of Surface Runoff in a Manner Which Would Result in Flooding On- or Offsite

Effects of Project Construction

The flood risk reduction projects and actions listed in Section 5.4.3.4 could include construction activities such as topographic grading, removing or relocating levee sections, exposing bare soil, placing dredged material, constructing structures and earthen enbankments, stockpiling construction materials, and changing vegetation that could substantially alter drainage patterns and create or increase on- and offsite flooding. The potential impacts to existing drainage patterns would be generally similar to those described above for water supply reliability projects in Section 5.4.3.1.1 and to those described in Section 5.4.3.2.1 for Delta ecosystem restoration projects related to floodplain restoration and expansion. Actual alteration of drainage patterns would depend on the type of the construction activity and local hydrologic and hydraulic factors. These impacts could be temporary and limited to the construction phase.

Setting back or relocating levees could also be included in any flood risk reduction project. Moving a levee further into a floodplain could remove some water storage space from the floodplain. Additionally, flooding from other sources (besides the stream on which the setback lies) could cause ponding along the land side of the new setback levee rather than against the original levee. Other conditions could then cause this ponding to be shifted away from the landside of the new levee, resulting in the flooding of new areas that were not previously at risk of flooding. This flooding could occur anywhere setbacks are constructed where the floodplain slopes down toward the existing and (replacement) setback levees.

It is not known at this time what types or where construction of specific flood risk reduction projects that could alter existing drainage patterns and flows would occur. However, in addition to levee construction and levee repairs, the Delta Plan encourages implementation of dredging to reduce flood risk, including such as would be involved in the Sacramento Deep Water Ship Channel and Stockton Deep Water Ship Channel Dredging Project (which has not undergone project-specific environmental review). A project that involves similar hydraulic dredging, and levee construction actions, the North Delta Flood Control and Ecosystem Restoration Project (DWR 2010e), has undergone project-specific environmental review.

The North Delta Flood Control and Ecosystem Restoration Project was discussed in the ecosystem restoration subsection (Section 5.4.3.2). The design of the project included levee improvements to accommodate some slight drainage pattern changes. In the EIR prepared for this project (DWR 2010e), DWR found the drainage pattern and flooding impacts to be less than significant.

Another document reviewed for potential impacts was the USACE Draft Supplemental EIS/EIR for the Sacramento River Deep Water Ship Channel (USACE and Port of West Sacramento 2011). The lead agency found that there would be no impact resulting from alteration of existing hydrology that would lead to erosion impacting the levees protecting Ryer and Prospect islands that would cause flooding of those islands.

Effects of Project Operations

The flood risk reduction projects and actions listed in Section 5.4.3.4 could include construction activities as described above that could substantially alter drainage patterns and create or increase on- and offsite flooding. The potential impacts to existing drainage patterns would be generally similar to those described above for water supply reliability projects in Section 5.4.3.1.1 and to those described in Section 5.4.3.2.1 for Delta ecosystem restoration projects related to floodplain restoration and expansion. Actual alteration of drainage patterns would depend on the type of activity and local hydrologic and hydraulic factors.

These impacts could persist through operation of the project, such as the flooding of a floodplain after construction.

Setting back or relocating levees could also be included in any flood risk reduction project. Moving a levee further into a floodplain could remove some water storage space from the floodplain. Additionally, flooding from other sources (besides the stream on which the setback lies) could cause ponding along the land side of the new setback levee rather than against the original levee. Other conditions could then cause this ponding to be shifted away from the landside of the new levee, resulting in the flooding of new areas that were not previously at risk of flooding. This flooding could occur anywhere setbacks are constructed where the floodplain slopes down toward the existing and (replacement) setback levees.

Operable barriers along levees could divert higher flood flows into flood bypasses. If the barriers are designed and operated properly, peak flood flows in the bypass should not increase, and management of storm-related flood flows could be better controlled.

It is not known at this time what types or where the operation of specific flood risk reduction projects that could alter existing drainage patterns and flows would occur. However, in addition to levee construction and levee repairs, the Delta Plan encourages implementation of dredging to reduce flood risk, including such as would be involved in the Sacramento Deep Water Ship Channel and Stockton Deep Water Ship Channel Dredging Project (which has not undergone project-specific environmental review). A project that involves similar hydraulic dredging, and levee construction actions, the North Delta Flood Control and Ecosystem Restoration Project (DWR 2010e), has undergone project-specific environmental review.

The North Delta Flood Control and Ecosystem Restoration Project was discussed in the ecosystem restoration subsection (Section 5.4.3.2). The design of the project included levee improvements to accommodate some slight drainage pattern changes. In the EIR prepared for this project (DWR 2010e), DWR found the drainage pattern and flooding impacts to be less than significant.

Another document reviewed for potential impacts was the USACE Draft Supplemental EIS/EIR for the Sacramento River Deep Water Ship Channel (USACE and Port of West Sacramento 2011). The lead agency found that there would be no impact resulting from alteration of existing hydrology that would lead to erosion impacting the levees protecting Ryer and Prospect Islands that would cause flooding of those islands.

Conclusion

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies, and these analyses will include more information on impacts resulting from climate change. During the project-level analyses, these impacts will be identified by drainage or hydrology and hydraulic studies, as they depend on various site-specific factors and on the proximity of the construction site to people, structures, and transportation routes. These types of impacts are likely to be most evident in areas prone to flooding, such as those identified on FEMA FIRMs, where tall and long features, such as setback levees, are constructed across the floodplain flow path. However, because named projects and projects encouraged by the Delta Plan could result in changes to drainage patterns that could cause flooding, this potential impact is considered **significant**.

5.4.3.4.2 Impact 5-2d: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Effects of Project Construction

The flood risk reduction projects and actions listed in Section 5.4.3.4 could include construction activities that could create or contribute stormwater runoff water to existing or planned stormwater drainage systems and could cause the capacities of those systems to be exceeded. The potential impacts to existing drainage systems would be generally similar to those described for water supply reliability projects in Section 5.4.3.1.2. Actual creations or contributions of stormwater runoff would depend on the type of the construction activity and local hydrologic and hydraulic factors. These impacts could be temporary and limited to the construction phase.

It is unclear at this time how specific components of the Proposed Project would be constructed because the details of the project are not currently known, including the location, number, methods, and duration. There are ongoing projects that are similar to these flood risk reduction projects, the environmental evaluation of which would be comparable to some of the actions/activities that would be expected with the encouraged projects. These ongoing projects include the North Delta Flood Control and Ecosystem Restoration Project (DWR 2010e).

In the North Delta Flood Control and Ecosystem Restoration Project EIR (DWR 2010e), DWR found all but one of the flood control and levee stability impacts to be less than significant. One potential impact, increased seepage, was determined to be significant. However, DWR found it could be reduced to less than significant through development of a seepage monitoring program.

Effects of Project Operations

The flood risk reduction projects and actions listed in Section 5.4.3.4 could include construction activities as described above. The potential impacts to existing drainage systems would be generally similar to those described for water supply reliability projects in Section 5.4.3.1.2. Actual creations or contributions of stormwater runoff would depend on the type of activity and local hydrologic and hydraulic factors. These impacts could persist through operation of the project.

It is unclear at this time how specific components of the flood risk reduction projects that would be encouraged by the Delta Plan would be constructed or operated because the details of these projects are not currently known, including the location and number. There are ongoing projects that are similar to this flood risk reduction project, the environmental evaluation of which would be comparable to some of the actions/activities that would be expected with the encouraged projects. The ongoing projects include the North Delta Flood Control and Ecosystem Restoration Project (DWR 2010e).

In the North Delta Flood Control and Ecosystem Restoration Project EIR (DWR 2010e), DWR found all but one of the flood control and levee stability impacts to be less than significant. One potential impact, increased seepage, was determined to be significant. However, DWR found it could be reduced to less than significant through development of a seepage monitoring program.

Conclusion

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies, and these analyses will include more information on impacts resulting from climate change. During the project-level analyses, these impacts will be identified by drainage or hydrology and hydraulic studies, as they depend on various site-specific factors and on the proximity of the construction site to people, structures, and transportation routes. However, because named projects and projects encouraged by the Delta Plan could result in changes to runoff that could exceed the capacity of existing stormwater drainage systems, this potential impact is considered **significant**.

5.4.3.4.3 Impact 5-3d: Place Housing Within a 100-year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map

Flood risk reduction projects encouraged by the Delta Plan could include the construction of levees and operable barriers along the levees, levee maintenance, levee modification, expansion of floodplains, and sediment removal from channels. These actions would not include placement of new housing within a 100-year flood hazard area, so there would be **no impact**.

5.4.3.4.4 Impact 5-4d: Expose People or Structures to a Significant Risk of Loss, Injury or Death Involving Flooding, Including Flooding as a Result of the Failure of a Levee or Dam

Effects of Project Construction

The flood risk reduction projects and actions listed in Section 5.4.3.4 could involve land grading, excavating, constructing large embankments, placing dredged materials, installing coffer dams, constructing structures, dewatering, and stockpiling of levee repair material. Short-term impacts to existing levee integrity and evacuation and emergency response times during construction would be similar to those described above for water supply reliability projects in Section 5.4.3.1.4. However, over the long-term, these flood risk reduction projects would be expected to decrease the current level of risk, resulting in beneficial impacts.

It is unclear at this time how specific components of the Proposed Project would be constructed because the details of the project are not currently known, including the location, number, methods, and duration. There are ongoing projects that are similar to these restoration projects, the environmental evaluation of which would be comparable to some of the actions/activities that would be expected with the encouraged projects. These ongoing projects include the North Delta Flood Control and Ecosystem Restoration Project (DWR 2010e).

In the North Delta Flood Control and Ecosystem Restoration Project EIR (DWR 2010e), DWR found all but one of the flood control and levee stability impacts to be less than significant. One potential impact, increased seepage, was determined to be significant. However, DWR found it could be reduced to less-than-significant through development of a seepage monitoring program.

Another document reviewed for potential impacts was the USACE Draft Supplemental EIS/EIR for the Sacramento River Deep Water Ship Channel (USACE and Port of West Sacramento 2011). The lead agency found that there would be no impact resulting from alteration of existing hydrology that would lead to erosion impacting the levees protecting Ryer and Prospect Islands that would cause flooding of those islands.

Effects of Project Operations

The flood risk reduction projects and actions listed in Section 5.4.3.4 could involve construction as described above and stockpiling of levee repair material. Over the long term, these flood risk reduction projects would be expected to decrease the current level of risk, resulting in beneficial impacts.

It is unclear at this time how specific components of the flood risk reduction projects that would be encouraged by the Delta Plan would be constructed because the details of these projects are not currently known, including the location and number. There are ongoing projects that are similar to these restoration projects, the environmental evaluation of which would be comparable to some of the actions/activities that would be expected with the encouraged projects. These ongoing projects include the North Delta Flood Control and Ecosystem Restoration Project (DWR 2010f).

In the North Delta Flood Control and Ecosystem Restoration Project EIR (DWR 2010f), DWR found all but one of the flood control and levee stability impacts to be less than significant. One potential impact, increased seepage, was determined to be significant. However, DWR found it could be reduced to less than significant through development of a seepage monitoring program.

Another document reviewed for potential impacts was the USACE Draft Supplemental EIS/EIR for the Sacramento River Deep Water Ship Channel (USACE and Port of West Sacramento 2011). The lead agency found that there would be no impact resulting from alteration of existing hydrology that would lead to erosion impacting the levees protecting Ryer and Prospect Islands that would cause flooding of those islands.

Conclusion

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies, and these analyses will include more information on impacts resulting from climate change. Because flood risk reduction projects are expected to decrease the current level of flood risk, the potential impacts of projects encouraged by the Delta Plan are considered **less than significant** and may be beneficial.

5.4.3.4.5 Impact 5-5d: Place Within a 100-year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Inundation by Seiche, Tsunami, or Mudflow

Effects of Project Construction

The flood risk reduction projects and actions listed in Section 5.4.3.4 could include construction activities such as topographic grading, removing or relocating levee sections, placing dredged material, constructing structures and earthen enbankments, and stockpiling of construction materials and levee repair materials that could substantially impede or redirect flood flows. The potential short-term impacts to flood flows during construction would be generally similar to those described for water supply reliability projects in Section 5.4.3.1.5. Actual alteration of flood flows would depend on the type of construction activity and local hydrologic and hydraulic factors. These impacts have the potential to occur at any construction site, which could, depending on various factors, lead to flooding.

Setting back or relocating levees could be included with any flood risk reduction project. Moving a levee further into a floodplain could remove some water storage space from the floodplain. Additionally, flooding from other sources (besides the stream on which the setback lies) could cause ponding along the land side of the new setback levee rather than against the original levee. Other conditions could then cause this ponding to be shifted away from the landside of the new levee, resulting in the flooding of new areas that were not previously at risk of flooding. This flooding could occur anywhere setbacks are constructed where the floodplain slopes down toward the existing and (replacement) setback levees.

It is unclear at this time how specific components of the projects that would be encouraged by the Delta Plan would be constructed because the details of these projects are not currently known, including the location, number, methods, and duration. However, over the long term, flood risk reduction projects and actions would be expected to decrease the current level of flood risk, resulting in beneficial impacts.

In the North Delta Flood Control and Ecosystem Restoration Project EIR (DWR 2010e), DWR found all but one of the flood control and levee stability impacts to be less than significant. One potential impact, increased seepage, was determined to be significant. However, DWR found it could be reduced to less than significant through development of a seepage monitoring program.

Effects of Project Operations

The flood risk reduction projects and actions listed in Section 5.4.3.4 could include construction activities as described above and stockpiling of levee repair materials that could substantially impede or redirect flood flows. The potential short-term impacts to flood flows during construction would be generally similar to those described for water supply reliability projects in Section 5.4.3.1.5. Actual alteration of flood flows would depend on the type of activity and local hydrologic and hydraulic factors. These impacts could persist through operation of the project.

Setting back or relocating levees could be included with any flood risk reduction project. Moving a levee further into a floodplain could remove some water storage space from the floodplain. Additionally, flooding from other sources (besides the stream on which the setback lies) could cause ponding along the land side of the new setback levee rather than against the original levee. Other conditions could then cause this ponding to be shifted away from the landside of the new levee, resulting in the flooding of new areas that were not previously at risk of flooding. This flooding could occur anywhere setbacks are constructed where the floodplain slopes down toward the existing and (replacement) setback levees.

It is unclear at this time how specific components of the flood risk reduction projects that would be encouraged by the Delta Plan would be constructed because the details of these projects are not currently known, including the location and number. However, over the long-term, flood risk reduction projects and actions would be expected to decrease the current level of flood risk, resulting in beneficial impacts.

In the North Delta Flood Control and Ecosystem Restoration Project EIR (DWR 2010f), DWR found all but one of the flood control and levee stability impacts to be less than significant. One potential impact, increased seepage, was determined to be significant. However, DWR found it could be reduced to less than significant through development of a seepage monitoring program.

Conclusion

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies, and these analyses will include more information on impacts resulting from climate change. However, because flood risk reduction projects are expected to decrease the current level of flood risk, the potential impacts of projects encouraged by the Delta Plan are considered **less than significant** and may be beneficial.

5.4.3.5 Protection and Enhancement of Delta as an Evolving Place

As described in Sections 2A, Proposed Project and Alternatives, and 2B, Introduction to Resource Sections, the Delta Plan does not direct the construction of specific projects, nor would projects be implemented under the direct authority of the Council. However, the Delta Plan seeks to protect and enhance the Delta as an evolving place by encouraging various actions and projects, which if taken could lead to completion, construction and/or operation of associated projects. Features of such actions and could include the following:

- Gateways, bike lanes, parks, trails, and marinas and facilities to support wildlife viewing, angling, and hunting opportunities
- Additional retail and restaurants in legacy towns to support tourism

The number and location of all potential projects that could be implemented is not currently known. However, three possible projects are known to some degree and are named in the Delta Plan, which are new State Parks at Barker Slough, Elkhorn Basin, and in the southern Delta.

5.4.3.5.1 Impact 5-1e: Substantially Alter the Existing Drainage Pattern of the Site or Area, Including Through the Alteration of the Course of a Stream or River, or Substantially Increase the Rate or Amount of Surface Runoff in a Manner Which Would Result in Flooding On- or Offsite

Effects of Project Construction

Delta enhancement projects and actions encouraged by the Delta Plan would include the construction of recreational trails, community gateways and visitor centers, new parks and waterfowl hunting opportunities. Any of these project facilities could include construction activities such as topographic grading, exposing bare soil, placing dredged material, constructing structures and earthen enbankments, stockpiling construction materials, and changing vegetation that could substantially alter drainage patterns and create or increase on- and offsite flooding. The potential impacts to existing drainage would be generally similar to those described for water supply reliability projects in Section 5.4.3.1.1. Actual alteration of drainage patterns would depend on the type of the construction activity and local hydrologic and hydraulic factors. These impacts could be temporary and limited to the construction phase.

It is not known at this time what types or where construction of specific Delta as evolving place types of projects that could alter existing drainage patterns and flow would occur. However, the Delta Plan encourages implementation of the Barker Slough and Elkhorn Basin State Parks and a new park somewhere in the southern Delta, none of which have undergone project-specific environmental review. There are ongoing projects that are similar to these park projects and that would be comparable to the general types of Delta-enhancing projects listed above. One of these ongoing projects that has undergone project-specific environmental review is the Bidwell-Sacramento River State Park Habitat Restoration and Outdoor Recreation Facilities Development Project. In the EIR for this project (The Nature Conservancy and California Department of Parks and Recreation 2008) the lead agency found that creation of access roads, parking, trails, and campgrounds, along with restoration of approximately 150 acres to native vegetation communities and removal of earthen berms along Mud Creek would result in a small change in flood elevation (decrease), but that project-related changes in local and downstream flood hydrology would be less than significant.

Effects of Project Operations

Delta enhancement projects and actions encouraged by the Delta Plan would include the construction as described above that could substantially alter drainage patterns and create or increase on-, as well as, offsite flooding. The potential impacts to existing drainage would be generally similar to those described for water supply reliability projects in Section 5.4.3.1.1. Actual alteration of drainage patterns would depend on the type of activity and local hydrologic and hydraulic factors. These impacts could persist through operation of the project.

It is not known at this time what types or where construction of specific Delta as evolving place types of projects that could alter existing drainage patterns and flow would occur. However, the Delta Plan encourages implementation of the Barker Slough and Elkhorn Basin State Parks and a new park somewhere in the southern Delta, none of which have undergone project-specific environmental review. There are ongoing projects that are similar to these park projects and that would be comparable to the general types of Delta-enhancing projects listed above. One of these ongoing projects that has undergone project-specific environmental review is the Bidwell-Sacramento River State Park Habitat Restoration and Outdoor Recreation Facilities Development Project. In the EIR for this project (The Nature Conservancy and DPR 2008), the lead agency found that creation of access roads, parking, trails, and campgrounds, along with restoration of approximately 150 acres to native vegetation communities and removal of earthen berms along Mud Creek, would result in a small change in flood elevation (decrease), but that project-related changes in local and downstream flood hydrology would be less than significant.

Conclusion

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies, and these analyses will include more information on impacts resulting from climate change. During the project-level analyses, these impacts will be identified by drainage or hydrology and hydraulic studies, as they depend on various site-specific factors and on the proximity of the construction site to people, structures, and transportation routes. These types of impacts are likely to be most evident in areas prone to flooding, such as those identified on FEMA FIRMs, where tall and long features are constructed across the floodplain flow path. However, because named projects and projects encouraged by the Delta Plan could result in changes to drainage patterns that could cause flooding, this potential impact is considered **significant**.

5.4.3.5.2 Impact 5-2e: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Effects of Project Construction

Delta enhancement projects encouraged by the Delta Plan would include the construction of recreational trails, community gateways and visitor centers, new parks and waterfowl hunting opportunities. Any of these project facilities could create or contribute stormwater runoff water to existing or planned stormwater drainage systems that could exceed the capacities of those systems. The potential impacts to existing drainage systems would be generally similar to those described for water supply reliability projects in Section 5.4.3.1.2. Actual creation or contribution of stormwater runoff would depend on the type of the construction activity and local hydrologic and hydraulic factors. These impacts could be temporary and limited to the construction phase.

It is unclear at this time how specific components of the Proposed Project would be constructed because the details of the project are not currently known, including the location, number, methods, and duration. As described above, the Bidwell-Sacramento River State Park Habitat Restoration and Outdoor Recreation Facilities Development Project EIR (The Nature Conservancy and DPR 2008) provides analogous information. The lead agencies for this project did not identify any impacts associated with runoff water.

Effects of Project Operations

Delta enhancement projects encouraged by the Delta Plan would include the construction as described above. Any of these project facilities could create or contribute stormwater runoff water to existing or planned stormwater drainage systems that could exceed the capacities of those systems. The potential impacts to existing drainage systems would be generally similar to those described for water supply reliability projects in Section 5.4.3.1.2. Actual creation or contribution of stormwater runoff would depend on the type of the construction activity and local hydrologic and hydraulic factors. These impacts could persist through operation of the project.

It is unclear at this time how specific components of the Proposed Project would be constructed because the details of the project are not currently known, including the location, number, methods, and duration. As described above, the Bidwell-Sacramento River State Park Habitat Restoration and Outdoor Recreation Facilities Development Project EIR (The Nature Conservancy and DPR 2008) provides analogous information. The lead agencies for this project did not identify any impacts associated with runoff water.

Conclusion

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies, and these analyses will include more information on impacts resulting from climate change. During the project-level analyses, these impacts will be identified by drainage or hydrology and hydraulic studies, as they depend on various site-specific factors and on the proximity of the construction site to people, structures, and transportation routes. However, because named projects and projects encouraged by the Delta Plan could result in changes to runoff that could exceed the capacity of existing stormwater drainage systems, the potential impacts are considered **significant**.

5.4.3.5.3 Impact 5-3e: Place Housing Within a 100-year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map

Delta enhancement projects encouraged by the Delta Plan would include the construction of recreational trails, community gateways and visitor centers, new parks, waterfowl hunting opportunities, and additional retail and restaurants in legacy towns to support tourism. These actions would not include placement of new housing within a 100-year flood hazard area, so there would be **no impact**.

5.4.3.5.4 Impact 5-4e: Expose People or Structures to a Significant Risk of Loss, Injury or Death Involving Flooding, Including Flooding as a Result of the Failure of a Levee or Dam

Effects of Project Construction

Delta enhancement projects encouraged by the Delta Plan would include the construction of recreational trails, community gateways and visitor centers, new parks and waterfowl hunting opportunities. Construction of these project elements or facilities at any site could involve land grading, excavating, constructing large embankments, placing dredged materials, constructing structures, dewatering, and stockpiling. Potential impacts would generally be similar to those described above for water supply reliability projects in Section 5.4.3.1.4.

It is unclear at this time how specific components of the Proposed Project would be constructed because the details of the project are not currently known, including the location, number, methods, and duration. As mentioned above, the Bidwell-Sacramento River State Park Habitat Restoration and Outdoor Recreation Facilities Development Project EIR (The Nature Conservancy and DPR 2008) provides analogous information. The lead agencies for this project did not identify any impacts associated with flooding or failure of a levee or dam.

Conclusion

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies, and these analyses will include more information on impacts resulting from climate change. During the project-level analyses, the levee integrity and evacuation and emergency response impacts will be identified based on geotechnical studies and on drainage or hydrology and hydraulic studies, as they depend on various site-specific hydrologic and hydraulic factors, geotechnical factors, and on the proximity of the project site to levees and other flood risk reduction facilities. However, because named projects and projects encouraged by the Delta Plan could adversely affect levee integrity, as well as the integrity of other water conveyance and storage facilities, and have adverse effects on evacuation and emergency response times, the potential impacts are considered **significant**.

5.4.3.5.5 Impact 5-5e: Place Within a 100-year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Inundation by Seiche, Tsunami, or Mudflow

Effects of Project Construction

Delta enhancement projects encouraged by the Delta Plan would include the construction of recreational trails, community gateways and visitor centers, new parks and waterfowl hunting opportunities. Any of these project facilities could include construction activities such as topographic grading, constructing structures and earthen enbankments, and stockpiling construction materials that could substantially impede or redirect flood flows. The potential impacts to flood flow would be similar to those described above for water supply reliability projects in Section 5.4.3.1.5. Actual alteration of flood flows would depend on the type of construction activity and local hydrologic and hydraulic factors. These impacts could be temporary and limited to the construction phase.

As with the types of actions already discussed, it is unclear at this time how specific components of the Proposed Project would be constructed because the details of the project are not currently known, including the location, number, methods, and duration. As mentioned above, the Bidwell-Sacramento River State Park Habitat Restoration and Outdoor Recreation Facilities Development Project EIR (The Nature Conservancy and DPR 2008) and San Luis Rey River Park Master Plan EIR (San Diego County Department of Parks and Recreation 2008) provide analogous information.

The North Bidwell-Sacramento River State Park Habitat Restoration and Outdoor Recreation Facilities Development Project would include outdoor recreation facilities such as new trails. The lead agency found that there could be a small change in flood elevation, but that project-related changes in local and downstream flood hydrology would be less than significant.

The San Luis Rey River Park Master Plan EIR (San Diego County Department of Parks and Recreation 2008) did not identify any impacts associated with impedance or redirection of flood flows or inundation due to seiche, tsunami or mudflow.

Effects of Project Operations

Delta enhancement projects encouraged by the Delta Plan would include the construction as described above that could substantially impede or redirect flood flows. The potential impacts to flood flow would be similar to those described above for water supply reliability projects in Section 5.4.3.1.5. Actual alteration of flood flows would depend on the type of construction activity and local hydrologic and hydraulic factors. These impacts could persist through operation of the project.

As with the types of actions already discussed, it is unclear at this time how specific components of the Proposed Project would be constructed because the details of the project are not currently known, including the location and number. As mentioned above, the Bidwell-Sacramento River State Park Habitat Restoration and Outdoor Recreation Facilities Development Project EIR (The Nature Conservancy and DPR 2008) and San Luis Rey River Park Master Plan EIR (San Diego County Department of Parks and Recreation 2008) provide analogous information.

The North Bidwell-Sacramento River State Park Habitat Restoration and Outdoor Recreation Facilities Development Project would include outdoor recreation facilities such as new trails. The lead agency found that there could be a small change in flood elevation, but that project-related changes in local and downstream flood hydrology would be less than significant.

The San Luis Rey River Park Master Plan EIR (San Diego County Department of Parks and Recreation 2008) did not identify any impacts associated with impedance or redirection of flood flows or inundation due to seiche, tsunami or mudflow.

Conclusion

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies, and these analyses will include more information on impacts resulting from climate change. During the project-level analyses, these impacts will be identified by drainage or hydrology and hydraulic studies, as they depend on various site-specific factors and on the proximity of the construction site to people, structures, and transportation routes. These types of impacts are likely to be most evident where tall and long features, such as setback levees, are constructed across the floodplain flow path. However, because named projects and projects encouraged by the Delta Plan could result in placement of structures which could impede or redirect flood flows, or increase the risk of inundation by seiche, tsunami, or mudflow, this potential impact is considered **significant**.

5.4.3.6 Mitigation Measures

Any covered action that would have one or more of the significant environmental impacts listed above shall incorporate the following features and/or requirements related to such impacts.

With regard to covered actions implemented under the Delta Plan, these mitigation measures will reduce the impacts of the Proposed Project. Project-level analysis by the agency proposing the covered action will determine whether the measures are sufficient to reduce those impacts to a less-than-significant level. Generally speaking, many of these measures are commonly employed to minimize the severity of an impact and in many cases would reduce impacts to a less-than-significant level, as discussed below in more detail.

With regard to actions taken by other agencies on the basis of Delta Plan recommendations (i.e., activities that are not covered actions), the implementation and enforcement of these measures would be within the responsibility and jurisdiction of public agencies other than the Council. Those agencies can and should adopt these measures as part of their approval of such actions, but the Council does not have the authority to require their adoption. Therefore, significant impacts of noncovered actions could remain **significant and unavoidable**.

How mitigation measures in this EIR relate to covered and noncovered actions is discussed in more detail in Section 2B, Introduction to Resource Sections.

5.4.3.6.1 Mitigation Measure 5-1

The following mitigation measures would reduce the effects of Impacts 5-1a through 5-1e, Substantially Alter the Existing Drainage Pattern of the Site or Area, Including Through the Alteration of the Course of a Stream or River, or Substantially Increase the Rate or Amount of Surface Runoff in a Manner Which Would Result in Flooding On- or Offsite:

- Prepare a drainage or hydrology and hydraulic study that would assess the need and provide a basis for the design of drainage-related mitigations, such as new onsite drainage systems or new cross drainage facilities. Prepare the study in accordance with applicable standards of FEMA, USACE, DWR, CVFPB, as well as the local reclamation districts and flood control agencies and the counties and cities. Design subsequent mitigation measures in accordance with the final study and with the applicable standards of FEMA, USACE, DWR, and CVFPB. The study would identify potential increases in flood risks, including those that may result from new facilities.

- Provide temporary drainage bypass facilities that would reroute drainage around, along, or over the Proposed Project facilities and construction sites. The temporary bypass facilities would be designed in accordance with the results and recommendations of a drainage or hydrologic and hydraulic study and would be in place and fully functional until long-term replacement facilities are completed.

- Provide onsite stormwater detention storage at construction and project facility sites that would reduce project-caused short- or long-term increases in drainage runoff. The storage space placement and capacity would be designed based on the drainage or hydrologic and hydraulic study.
- Based on the results of the drainage or hydrologic and hydraulic study, arrange the length of any stockpiles or other construction features in the direction of the floodplain flow to maximize surface flows under flood flow conditions.
- At in-stream construction sites that might reduce channel capacity, install setback levees or bypass channels to maintain channel capacity and to mitigate hydraulic impacts.
- Where low channel velocities might result from construction, implement a sediment management program in order to maintain channel capacity.
- Provide cross drainage, replacement drainage paths and facilities, and enlarged flow paths to reroute drainage around, under, or over the Proposed Project facilities and to restore the function of any affected existing drainage or flow paths and facilities.
- Channel modifications for restoration actions would be required to be implemented to maintain or improve flood management functions and would be coordinated with the USACE, DWR, CVFPB, and other flood control agencies to assess the desirability and feasibility for channel modifications. To the extent consistent with floodplain land uses and flood control requirements, if applicable, woody riparian vegetation would be allowed to naturally establish.
- For areas that would be flooded as a result of the project, or where existing flooding would be increased in magnitude, frequency, or duration, purchase a flowage easement and/or property at the fair-market value.
- Provide a long-term sediment removal program at in-river structures.
- To mitigate potential impacts of changes in the timing of reservoir releases or the possible combination of river peak flows, use forecasts to implement coordination of operations with existing reservoirs.

These mitigation measures are commonly employed on a variety of construction projects. In many cases, they reduce significant construction-related flood management impacts to less-than-significant levels. Implementation of these mitigation measures would reduce the significance of construction-related and operations-related flood management impacts by completion of site-specific hydrology and hydraulic studies, temporary bypasses, onsite storage, and channel modifications. In some cases it will not be feasible to fully implement the mitigation measures in a manner that completely eliminates flood-management-related impacts due to local hydrology and topography. Moreover, as discussed above, with regard to actions taken by other agencies on the basis of Delta Plan recommendations (i.e., activities that are not covered actions), the implementation and enforcement of these measures would be within the responsibility and jurisdiction of public agencies other than the Council. For these reasons, construction-related and operations-related flood management impacts would remain **significant**.

5.4.3.6.2 Mitigation Measure 5-2

The following mitigation measures would reduce the effects of Impacts 5-2a through 5-2e, Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff:

- Prepare a drainage or hydrology and hydraulics study that would assess the need and provide a basis for the design of drainage-related mitigations, such as new onsite drainage systems or new cross drainage facilities. Prepare the study in accordance with applicable standards of FEMA, USACE, DWR, CVFPB, as well as the local reclamation districts and flood control agencies and the counties and cities. Design subsequent mitigation measures in accordance with the final study and with the applicable standards of FEMA, USACE, DWR, and CVFPB.

- Provide onsite stormwater detention storage at construction and project facility sites that would reduce project-caused, short- and long-term increases in drainage runoff. The storage space would be designed based on the drainage or hydrologic and hydraulic study.

These mitigation measures are commonly employed on a variety of construction projects. In many cases, they reduce significant construction-related flood management impacts to less-than-significant levels. Implementation of these mitigation measures would reduce the significance of construction-related and operations-related flood management impacts by site-specific hydrology and hydraulic studies and onsite storage. In some cases it will not be feasible to fully implement the mitigation measures in a manner that completely eliminates flood-management-related impacts due to local hydrology and topography. Moreover, as discussed above, with regard to actions taken by other agencies on the basis of Delta Plan recommendations (i.e., activities that are not covered actions), the implementation and enforcement of these measures would be within the responsibility and jurisdiction of public agencies other than the Council. For these reasons, construction-related and operations-related flood management impacts would remain **significant**.

5.4.3.6.3 Mitigation Measure 5-4

The following mitigation measures would reduce the effects of Impacts 5-4a through 5e, Expose People or Structures to a Significant Risk of Loss, Injury or Death Involving Flooding, Including Flooding as a Result of the Failure of a Levee or Dam:

- Prepare a drainage or hydrology and hydraulics study that would assess the need and provide a basis for the design of drainage-related mitigations, such as new onsite drainage systems or new cross drainage facilities. Prepare the study in accordance with applicable standards of FEMA, USACE, DWR, CVFPB, as well as the local reclamation districts and flood control agencies and the counties and cities. Design subsequent mitigation measures in accordance with the final study and with the applicable standards of FEMA, USACE, DWR, and CVFPB.
- Where high channel velocities might result from construction, provide bank protection, such as rip rap, to protect levees from erosion.
- Where construction results in longer channel wind fetch lengths, install wave erosion protection on the water side slope of levees, such as rock or grouted rip rap, and increase levee freeboard to address higher wind and wave runup.
- Based on the drainage or hydrology and hydraulics study, determine any resulting changes to available evacuation plans or emergency response times.
- To reduce emergency response times and public safety risks, raise structures and major roads out of the floodplain.
- Provide automated flood warning systems.
- Develop and implement area-specific evacuation and emergency response plans.
- Considering the results of the hydraulics study noted above, perform a seepage and stability analyses that would assess the need and act as a basis for design of other seepage- and stability-related mitigations, such as cutoff walls, adjacent levees, setback levees, berms, and subdrainage

features. Perform the analyses in accordance with applicable standards of FEMA, USACE, and DWR.

- Perform research and collect subsurface information in accordance with applicable standards of FEMA, USACE, and DWR and perform settlement analyses that would assess the need for monitoring and potential settlement-related mitigations, such as ground improvement or pre-construction surcharging. Perform the analyses in accordance with applicable standards of USACE.
- Perform research and collect subsurface information in accordance with applicable standards of FEMA, USACE, and DWR and perform seismic and liquefaction analyses that would assess the need and provide the basis for design of other seismic-related mitigations, such as ground improvement. Perform the analyses in accordance with applicable standards of USACE and American Society of Civil Engineers and Southern California Earthquake Center.
- Prepare and implement a plan for periodic maintenance, inspections, repair, and rehabilitation of new water storage and conveyance facilities that could cause flooding upon failure.
- Provide redundancy and safety controls and devices on water storage and conveyance facilities (pump stations, canals, and tunnels) to protect against facility failure and subsequent flooding.
- To limit flooding from the unlikely event of a conveyance facility failure, limit extensive flow escape with installation of safety devices such as gated checks.
- Construct new evacuation roads and access roads, as necessary.
- Conduct Golden Guardian emergency drills.[1]

These mitigation measures are commonly employed on a variety of construction projects. In many cases, they reduce significant construction-related flood management impacts to less-than-significant levels. Implementation of these mitigation measures would reduce the significance of construction-related and operations-related flood management impacts by site-specific hydrology and hydraulic studies, channel modifications, and emergency preparedness and response programs. In some cases it will not be feasible to fully implement the mitigation measures in a manner that completely eliminates flood-management-related impacts due to local hydrology and topography. Moreover, as discussed above, with regard to actions taken by other agencies on the basis of Delta Plan recommendations (i.e., activities that are not covered actions), the implementation and enforcement of these measures would be within the responsibility and jurisdiction of public agencies other than the Council. For these reasons, construction-related and operations-related flood management impacts would remain **significant**.

5.4.3.6.4 Mitigation Measure 5-5

The following mitigation measures would reduce the effects of Impacts 5-5a through 5e, Place Within a 100-year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Inundation by Seiche, Tsunami, or Mudflow:

- Prepare a drainage or hydrology and hydraulics study that would assess the need and provide a basis for the design of drainage-related mitigations, such as new onsite drainage systems or new cross drainage facilities. Prepare the study in accordance with applicable standards of FEMA, USACE, DWR, CVFPB, as well as the local reclamation districts and flood control agencies and

[1] First implemented in 2004, Golden Guardian, California's Annual Statewide Exercise Series, has become the most comprehensive state-level exercise series program in the country. The goal of Golden Guardian is to exercise and assess emergency operations plans, policies, and procedures for all-hazards/catastrophic incidents at the local, regional, and state levels, as described in subsection 5.3.7.2.2.

the counties and cities. Design subsequent mitigation measures in accordance with the final study and with the applicable standards of FEMA, USACE, DWR, and CVFPB. Provide temporary drainage bypass facilities that would reroute drainage around, along, or over the Proposed Project facilities and construction sites. The temporary bypass facilities would be designed in accordance with drainage or hydrology and hydraulic study and would be in place and fully functional until long-term replacement facilities are completed.

- Based on the results of the drainage or hydrologic and hydraulic study, arrange the length of any stockpiles or other construction features in the direction of the floodplain flow to maximize surface flows under flood conditions.
- At in-stream construction sites that might reduce channel capacity, install setback levees or bypass channels to maintain channel capacity and to mitigate hydraulic impacts.
- Provide cross drainage, replacement drainage paths and facilities, and enlarged flow paths to reroute drainage around, under, or over the Proposed Project facilities and to restore the function of any affected existing drainage or flow paths and facilities.
- Channel modifications for restoration actions would be required to be implemented to maintain or improve flood management functions and would be coordinated with the USACE, DWR, CVFPB, and other flood control agencies to assess the desirability and feasibility for channel modifications. To the extent consistent with floodplain land uses and flood control requirements, if applicable, woody riparian vegetation would be allowed to naturally establish.

These mitigation measures are commonly employed on a variety of construction projects. In many cases, they reduce significant construction-related flood management impacts to less-than-significant levels. Implementation of these mitigation measures would reduce the significance of construction-related and operations-related flood management impacts by site-specific hydrology and hydraulic studies and channel modifications. In some cases it will not be feasible to fully implement the mitigation measures in a manner that completely eliminates flood-management-related impacts due to local hydrology and topography. Moreover, as discussed above, with regard to actions taken by other agencies on the basis of Delta Plan recommendations (i.e., activities that are not covered actions), the implementation and enforcement of these measures would be within the responsibility and jurisdiction of public agencies other than the Council. For these reasons, construction-related and operations-related flood management impacts would remain **significant**.

5.4.4 No Project Alternative

As described in Section 2A, Proposed Project and Alternatives, the No Project Alternative is based on the continuation of existing plans and policies and the continued operation of existing facilities into the future and permitted and funded projects. Seven ongoing projects have been identified as part of the No Project Alternative. The list of projects included in the No Project Alternative is presented in Table 2-2.

The No Project Alternative includes various water supply projects and one ecosystem enhancement project, as described in Section 2A, Proposed Project and Alternatives. These generally would have the same types of impacts on flood management as would occur under the Proposed Project. However, the Delta Plan would not be in place to encourage various other projects to move forward. To the extent the absence of the Delta Plan results in those projects not happening, there would be no flood management impacts associated with them.

Compared to the Proposed Project, the No Project Alternative would result in fewer actions and projects to improve water supply reliability, restore the Delta ecosystem, improve water quality, reduce flood risk, and protect and enhance the Delta as an evolving place. Overall, the reduced number of projects and actions under the No Project Alternative would reduce the impacts on flood management resulting from construction and operation of those projects. In addition to a general reduction in the number of projects with relatively small construction footprints, the large-scale surface water storage facilities and increased levee modification and maintenance encouraged under the Proposed Project would not move forward under the No Project Alternative, and the impacts associated with these projects would not occur.

Importantly, however, the benefits to flood management resulting from ecosystem restoration and projects that support habitat development (e.g., setback levees and floodplain expansion) and reduced flood risks would not be realized under the No Project Alternative. As described in the Section 5.3 (Environmental Setting), conditions in the Delta flood management have declined and continue to decline primarily as a result of conditions of levees and human influence on upstream water resources and Delta channels. Given the reduced number and magnitude of actions under the No Project Alternative (e.g., large-scale floodplain expansion and increased levee design criteria) to improve the current conditions or arrest further decline, on balance the overall adverse impacts on flood management resulting from the No Project Alternative would be **greater than** those under the Proposed Project, even though temporary impacts from construction would be fewer.

5.4.5 Alternative 1A

Under Alternative 1A, the construction and operation of surface water projects (water intakes, treatment and conveyance facilities, and reservoirs) would be the same as the Proposed Project. As described in Section 2A, Proposed Project and Alternatives, there would be fewer groundwater projects (wells, wellhead treatment, conveyance facilities), ocean desalination projects, recycled wastewater and stormwater projects (treatment and conveyance facilities), water transfers, and water use efficiency and conservation programs would be reduced relative to the Proposed Project.

Projects to restore the Delta ecosystem would be reduced relative to the Proposed Project, and the implementation of flow objectives that could lead to a more natural flow regime in the Delta would not be accelerated. Stressor management activities and invasive species management (including removal of invasive vegetation) would be the same as described for the Proposed Project.

Projects and actions to improve water quality would be the same as under the Proposed Project. Flood risk reduction projects also would be the same as the Proposed Project, except that levee maintenance and modification would be less emphasized on levees that protect agricultural land and more emphasized on levees that protect water supply corridors, which could result in an overall reduction in these activities. Projects to protect and enhance the Delta as an evolving place would be the same as the Proposed Project.

5.4.5.1.1 Impact 5-1: Substantially Alter the Existing Drainage Pattern of the Site or Area, Including Through the Alteration of the Course of a Stream or River, or Substantially Increase the Rate or Amount of Surface Runoff in a Manner Which Would Result in Flooding On- or Offsite

The same types of impacts related to drainage pattern alteration from construction and operation of water supply reliability projects would occur under Alternative 1A as described under the Proposed Project. However, alteration of drainage patterns and runoff resulting from groundwater projects, ocean desalination projects, recycled wastewater and stormwater projects, water transfers, and water use efficiency would be less likely under Alternative 1A than the Proposed Project because of fewer projects or actions because many of the policies in the Proposed Project only would be recommendations under Alternative 1A. Construction impacts associated with ecosystem restoration also would be reduced because fewer projects would be constructed. This reduction in activity and construction would decrease the potential for drainage patterns and surface runoff to be adversely affected.

Projects and actions to improve water quality would be the same as under the Proposed Project. Flood risk reduction projects also would be the same as under the Proposed Project, except that there would be less emphasis on levee modification for levees that protect many agricultural lands and more emphasis on levees that protect water supply corridors, which could result in an overall reduction in these activities. Projects to protect and enhance the Delta as an evolving place would be the same as for the Proposed Project.

Given the reduced number and magnitude of actions under the Alternative 1A (e.g., floodplain protection and levee investments not necessarily based upon cost-benefits) to improve the current conditions or arrest further decline that could cause levee breaches and changes in Delta flow patterns, on balance the overall adverse impacts on flood management resulting from Alternative 1A would be **greater than** those under the Proposed Project, even though temporary impacts from construction might be fewer.

As compared to existing conditions, the impacts related to alteration of drainage patterns and surface runoff under Alternative 1A would be **significant**.

5.4.5.1.2 Impact 5-2: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Impacts on existing or planned stormwater drainage systems and the likelihood of contributing additional sources of polluted runoff would be reduced relative to the Proposed Project under Alternative 1A for the reasons described in Section 5.4.5.1.1. The overall extent of impacts to existing drainage systems would likely be less than for the Proposed Project because fewer total projects would be constructed, depending on the specific hydrologic and hydraulic factors of levee improvement actions/activities.

Overall, significant impacts on existing or planned stormwater drainage systems under Alternative 1A would be **less than** under the Proposed Project.

As compared to existing conditions, the impacts on existing or planned stormwater drainage systems under Alternative 1A would be **significant**.

5.4.5.1.3 Impact 5-3: Place Housing Within a 100-year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map

Projects encouraged by Alternative 1A would not include placement of new housing within a 100-year flood hazard area. Therefore, there would be **no impact**.

5.4.5.1.4 Impact 5-4: Expose People or Structures to a Significant Risk of Loss, Injury or Death Involving Flooding, Including Flooding as a Result of the Failure of a Levee or Dam

Impacts on flood risk would be reduced relative to the Proposed Project under Alternative 1A for the reasons described in Sections 5.4.5.1.1 and 5.4.5.1.2. Because flood risk reduction projects also would be the same as the Proposed Project, except that levee maintenance and modification would be less emphasized on levees that protect many agricultural lands and more emphasized on levees that protect water supply corridors, which could result in an overall reduction in these activities, long-term flood protection would be less than under the Proposed Project.

Given the reduced number and magnitude of actions under the Alternative 1A (e.g., floodplain protection and levee investments not necessarily based upon cost-benefits) to improve the current conditions or arrest further decline that could cause levee breaches and changes in Delta flow patterns, on balance the overall adverse impacts on flood management resulting from Alternative 1A would be **greater than** those under the Proposed Project, even though temporary impacts from construction might be fewer.

As compared to existing conditions, the impacts associated with flooding as a result of levee or dam failure under Alternative 1A would be **significant**.

5.4.5.1.5 Impact 5-5: Place Within a 100-year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Inundation by Seiche, Tsunami, or Mudflow

Impacts on flood management associated with placement of structures within a 100-year flood hazard area that would impede or redirect flood flows would be reduced relative to the Proposed Project under Alternative 1A for the reasons described in Section 5.4.5.1.1. The overall extent of impacts associated with placement of structures within a 100-year flood hazard area would likely be less than for the Proposed Project because fewer total projects would be constructed, depending on the specific hydrologic and hydraulic factors of levee improvement actions and activities.

Overall, significant impacts associated with placement of structures within a 100-year flood hazard area under Alternative 1A would be **less than** under the Proposed Project.

As compared to existing conditions, the impacts associated with placement of structures within a 100-year flood hazard area under Alternative 1A would be **significant**.

5.4.5.2 Mitigation Measures

Mitigation measures for impacts associated with Alternative 1A would be the same as those described for the Proposed Project in Sections 5.4.3.6.1 (Mitigation Measure 5-1), 5.4.3.6.2 (Mitigation Measure 5-2), 5.4.3.6.3 (Mitigation Measure 5-4), and 5.4.3.6.4 (Mitigation Measure 5-5). Because it is not known whether the mitigation measures listed above would reduce impacts to a less-than-significant level for Alternative 1A, these potential impacts are considered **significant and unavoidable**.

5.4.6 Alternative 1B

Under Alternative 1B, the construction and operation of surface water projects (water intakes, treatment and conveyance facilities, and reservoirs) would be the same as under the Proposed Project. As described in Section 2A, Proposed Project and Alternatives, there would be fewer groundwater projects (wells, wellhead treatment, conveyance facilities), recycled wastewater and stormwater projects (treatment and conveyance facilities), and water transfers compared with the Proposed Project. Water use efficiency and conservation programs also would be reduced relative to the Proposed Project. There would be no ocean desalination projects.

Projects to restore the Delta ecosystem would be reduced in extent relative to the Proposed Project and would not emphasize restoration of floodplains in the lower San Joaquin River. Implementation of flow objectives would not be accelerated or include public trust considerations. Ecosystem stressor management activities and invasive species management (including removal of invasive vegetation) would be increased relative to the Proposed Project, but a variance to the USACE Levee Vegetation Policy would not be pursued. In addition, Alternative 1B would not require conformance with the habitat types and elevation maps presented in the Ecosystem Restoration Program Conservation Strategy for Stage 2 Implementation, Sacramento-San Joaquin Delta and Suisun Marsh and Bay Planning Area.

Water quality improvement projects, including water treatment plants, conveyance facilities, and wells and wellhead treatment facilities, would be less emphasized relative to the Proposed Project, and greater emphasis would be placed on the construction and operation of wastewater treatment and recycling facilities and municipal stormwater treatment facilities.

Flood risk reduction would place greater emphasis on levee modification and maintenance and dredging than under the Proposed Project, but there would be no setback levees or subsidence reversal projects. Floodplain expansion projects would be fewer or less extensive, and use of reservoir reoperation would be reduced. Actions to protect and enhance the Delta as an evolving place would be consistent with the Economic Sustainability Plan, but creating new parks in the Delta, as encouraged by the Proposed Project, would not be emphasized.

5.4.6.1.1 Impact 5-1: Substantially Alter the Existing Drainage Pattern of the Site or Area, Including Through the Alteration of the Course of a Stream or River, or Substantially Increase the Rate or Amount of Surface Runoff in a Manner Which Would Result in Flooding On- or Offsite

The same types of impacts related to drainage pattern alteration from construction and operation of water supply reliability projects would occur under Alternative 1B as described under the Proposed Project. However, alteration of drainage patterns and runoff due to groundwater projects, ocean desalination projects, recycled wastewater and stormwater projects, water transfers, and water use efficiency would be less likely under Alternative 1B than the Proposed Project because of fewer projects or actions. Construction impacts associated with ecosystem restoration also would be reduced because fewer projects would be constructed. This reduction in activity and construction would decrease the potential for drainage patterns and surface runoff to be adversely affected.

Alternative 1B would not require conformance with the habitat types and elevation maps presented in the Ecosystem Restoration Program Conservation Strategy for Stage 2 Implementation, Sacramento-San Joaquin Delta and Suisun Marsh and Bay Planning Area, which could reduce the amount of tidal marsh that would be restored, leading to a reduction in impacts because fewer projects would be constructed.

Under Alternative 1B, the emphasis on the types of water quality improvement projects would shift toward more wastewater treatment and recycling facilities and more municipal stormwater treatment facilities and fewer of the other types of water quality improvement facilities. It is unclear if this shift would result in more or less construction activity; therefore, flood management impacts are expected to be similar to those under the Proposed Project.

Flood risk reduction projects also would be the same as under the Proposed Project, except that there would be less emphasis on levee modification for levees that protect some agricultural land and more emphasis on levees that protect water supply corridors, which could result in an overall reduction in these activities. Projects to protect and enhance the Delta as an evolving place would be the same as for the Proposed Project.

Given the reduced number and magnitude of actions under the Alternative 1B (e.g., floodplain protection and levee investments for many areas) to improve the current conditions or arrest further decline which could cause levee breaches and changes in Delta flow patterns, on balance the overall adverse impacts on flood management resulting from Alternative 1A would be **greater than** those under the Proposed Project, even though temporary impacts from construction might be fewer.

As compared to existing conditions, the impacts related to alteration of drainage patterns and surface runoff under Alternative 1B would be **significant**.

5.4.6.1.2 Impact 5-2: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Impacts on existing or planned stormwater drainage systems and the likelihood of contributing additional sources of polluted runoff would be reduced relative to the Proposed Project under Alternative 1B for the reasons described in Section 5.4.6.1.1. The overall extent of impacts to existing drainage systems would likely be less than for the Proposed Project because fewer total projects would be constructed, depending on the specific hydrologic and hydraulic factors of levee improvement actions/activities.

Overall, significant impacts on existing or planned stormwater drainage systems under Alternative 1B would be **less than** under the Proposed Project.

As compared to existing conditions, the impacts on existing or planned stormwater drainage systems under Alternative 1B would be **significant**.

5.4.6.1.3 Impact 5-3: Place Housing Within a 100-year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map

Projects encouraged by Alternative 1B would not include placement of new housing within a 100-year flood hazard area. Therefore, there would be **no impact**.

5.4.6.1.4 Impact 5-4: Expose People or Structures to a Significant Risk of Loss, Injury or Death Involving Flooding, Including Flooding as a Result of the Failure of a Levee or Dam

Impacts on flood risk would be reduced relative to the Proposed Project under Alternative 1B for the reasons described in Sections 5.4.6.1.1 and 5.4.6.1.2. Because flood risk reduction projects also would be the same as the Proposed Project, except that levee maintenance and modification would be less emphasized on levees that protect many agricultural lands and more emphasized on levees that protect water supply corridors, which could result in an overall reduction in these activities, long-term flood protection would be less than under the Proposed Project.

Given the reduced number and magnitude of actions under the Alternative 1B (e.g., floodplain protection and levee investments not necessarily based upon cost-benefits) to improve the current conditions or arrest further decline which could cause levee breaches and changes in Delta flow patterns, on balance the overall adverse impacts on flood management resulting from Alternative 1B would be **greater than** those under the Proposed Project, even though temporary impacts from construction might be fewer.

As compared to existing conditions, the impacts associated with flooding as a result of levee or dam failure under Alternative 1B would be **significant**.

5.4.6.1.5 Impact 5-5: Place Within a 100-year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Inundation by Seiche, Tsunami, or Mudflow

Impacts on flood management associated with placement of structures within a 100-year flood hazard area that would impede or redirect flood flows would be reduced relative to the Proposed Project under Alternative 1B for the reasons described in Section 5.4.6.1.1. The overall extent of impacts associated with placement of structures within a 100-year flood hazard area would likely be less than for the Proposed Project because fewer total projects would be constructed, depending on the specific hydrologic and hydraulic factors of levee improvement actions and activities.

Overall, significant impacts associated with placement of structures within a 100-year flood hazard area under Alternative 1B would be **less than** under the Proposed Project.

As compared to existing conditions, the impacts associated with placement of structures within a 100-year flood hazard area under Alternative 1B would be **significant**.

5.4.6.2 Mitigation Measures

Mitigation measures for impacts associated with Alternative 1B would be the same as those described for the Proposed Project in Sections 5.4.3.6.1 (Mitigation Measure 5-1), 5.4.3.6.2 (Mitigation Measure 5-2), 5.4.3.6.3 (Mitigation Measure 5-4), and 5.4.3.6.4 (Mitigation Measure 5-5). Because it is not known whether the mitigation measures listed above would reduce impacts to a less-than-significant level for Alternative 1B, these potential impacts are considered **significant and unavoidable**.

5.4.7 Alternative 2

As described in Section 2A, Proposed Project and Alternatives, Alternative 2 would place greater emphasis on groundwater, ocean desalination, water transfers, water use efficiency and conservation, and recycled water projects and less emphasis on surface water projects. The surface storage reservoirs considered under the DWR Surface Water Storage Investigation would not be encouraged; instead, surface storage in the Tulare Basin would be emphasized. Ecosystem restoration projects similar to but less extensive than those encouraged by the Proposed Project would be emphasized without the requirement to conform to the Ecosystem Restoration Program habitat types and elevation map. Alternative 2 would emphasize the development of flow objectives that take into consideration updated flow criteria that support a more natural flow regime, water rights, and greater protection of public trust resources.

Actions to improve water quality would be similar to or greater than those under the Proposed Project, especially the treatment of wastewater and agricultural runoff. Actions to reduce flood risk under Alternative 2 would emphasize floodplain expansion and reservoir reoperation rather than levee construction and modification. The stockpiling of rock and encouragement of subsidence reversal projects would be the same as under the Proposed Project, as would actions to protect and enhance the Delta as an evolving place.

5.4.7.1.1 Impact 5-1: Substantially Alter the Existing Drainage Pattern of the Site or Area, Including Through the Alteration of the Course of a Stream or River, or Substantially Increase the Rate or Amount of Surface Runoff in a Manner Which Would Result in Flooding On- or Offsite

The same types of impacts related to drainage pattern alteration from construction and operation of water supply reliability projects would occur under Alternative 2 as described under the Proposed Project. However, there would be more construction of groundwater, ocean desalination, and recycled water facilities under Alternative 2, potentially resulting in a greater likelihood that existing drainage patterns and surface runoff could be altered under Alternative 2 than they would under the Proposed Project. Because Alternative 2 would not encourage surface storage at the locations considered by the DWR Surface Water Storage Investigation, potential flood management impacts that could result from those projects would not occur. However, surface storage in the Tulare Basin would be emphasized and could lead to alteration of drainage patterns and surface runoff comparable to the surface water storage projects under the Proposed Project.

Alternative 2 would not require conformance with the habitat types and elevation maps presented in the Ecosystem Restoration Program Conservation Strategy for Stage 2 Implementation, Sacramento-San Joaquin Delta and Suisun Marsh and Bay Planning Area, which could reduce the amount of tidal marsh that would be restored, leading to a reduction in impacts because fewer projects would be constructed. Alternative 2 would emphasize the development of flow objectives that take into consideration flow criteria that support a more natural flow regime and greater protection of Public Trust resources. These types of flow criteria could modify reservoir releases and result in more water in Delta channels in the spring or fall months that could result in changes in flow patterns and seepage.

Under Alternative 2, the emphasis on the types of water quality improvement projects would focus on wastewater treatment and recycle facilities and more municipal stormwater treatment facilities. It is unclear if this would result in more or less construction activity; therefore, flood management impacts are expected to be similar to those under the Proposed Project. An emphasis on floodplain expansion and reservoir reoperation rather than levee construction and modification under Alternative 2 could reduce the potential for significant impacts related to alteration of drainage patterns and surface runoff relative to the Proposed Action.

Overall, significant impacts related to alteration of drainage patterns associated with construction of facilities could be less than under the Proposed Project. However, on balance the overall adverse impacts on flood management resulting from Alternative 2 would be **greater than** those under the Proposed Project, even though temporary impacts from construction might be fewer.

As compared to existing conditions, the impacts related to alteration of drainage patterns and surface runoff under Alternative 2 would be **significant**.

5.4.7.1.2 Impact 5-2: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Impacts on existing or planned stormwater drainage systems and the likelihood of contributing additional sources of polluted runoff would be reduced relative to the Proposed Project under Alternative 2 for the reasons described in Section 5.4.7.1.1. The overall extent of impacts to existing drainage systems would likely be less than for the Proposed Project because fewer total projects would be constructed, depending on the specific hydrologic and hydraulic factors of levee improvement actions/activities.

Overall, significant impacts on existing or planned stormwater drainage systems under Alternative 2 would be **less than** under the Proposed Project.

As compared to existing conditions, the impacts on existing or planned stormwater drainage systems under Alternative 2 would be **significant**.

5.4.7.1.3 Impact 5-3: Place Housing Within a 100-year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map

Projects encouraged by Alternative 2 would not include placement of new housing within a 100-year flood hazard area. Thus, there would be **no impact**.

5.4.7.1.4 Impact 5-4: Expose People or Structures to a Significant Risk of Loss, Injury or Death Involving Flooding, Including Flooding as a Result of the Failure of a Levee or Dam

The same types of impacts related to drainage pattern alteration from construction and operation of water supply reliability projects would occur under Alternative 2 as described under the Proposed Project. However, there would be more construction of groundwater, ocean desalination, and recycled water facilities under Alternative 2, potentially resulting in a greater likelihood that these structures could be exposed to significant risk under Alternative 2 than the Proposed Project. Because Alternative 2 would not encourage surface storage at the locations considered by the DWR Surface Water Storage Investigation, there would be a reduced likelihood of dam failure associated with those projects. However, surface storage in the Tulare Basin would be emphasized and could lead to risk of dam failure comparable to the surface water storage projects under the Proposed Project.

Alternative 2 would emphasize the development of flow objectives that take into consideration updated flow criteria that support a more natural flow regime and greater protection of Public Trust resources. It is unclear what effect these actions would have on overall risk of flooding as a result of dam or levee failure.

Overall, significant impacts associated with flooding as a result of levee or dam failure under Alternative 2 would be the **same as** the Proposed Project.

As compared to existing conditions, the impacts associated with flooding as a result of levee or dam failure under Alternative 1B would be **significant**.

5.4.7.1.5 Impact 5-5: Place Within a 100-year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Inundation by Seiche, Tsunami, or Mudflow

Impacts on flood management associated with placement of structures within a 100-year flood hazard area that would impede or redirect flood flows would be reduced relative to the Proposed Project under Alternative 2 for the reasons described in Section 5.4.7.1.1. The overall extent of impacts associated with placement of structures within a 100-year flood hazard area would likely be less than for the Proposed Project because fewer total projects would be constructed, depending on the specific hydrologic and hydraulic factors of levee improvement actions and activities.

Overall, significant impacts associated with placement of structures within a 100-year flood hazard area under Alternative 2 would be **less than** under the Proposed Project.

As compared to existing conditions, the impacts associated with placement of structures within a 100-year flood hazard area under Alternative 3 would be **significant**.

5.4.7.2 Mitigation Measures

Mitigation measures for impacts associated with Alternative 2 would be the same as those described for the Proposed Project in Sections 5.4.3.6.1 (Mitigation Measure 5-1), 5.4.3.6.2 (Mitigation Measure 5-2), 5.4.3.6.3 (Mitigation Measure 5-4), and 5.4.3.6.4 (Mitigation Measure 5-5). Because it is not known whether the mitigation measures listed above would reduce impacts to a less-than-significant level for Alternative 2, these potential impacts are considered **significant and unavoidable**.

5.4.8 Alternative 3

As described in Section 2A, Proposed Project and Alternatives, the water supply reliability projects and actions under Alternative 3 would be similar to those of the Proposed Project, although there would be less emphasis on surface water projects. Ecosystem restoration (floodplain restoration, riparian restoration, tidal marsh restoration, and floodplain expansion) would be reduced relative to the Proposed Project, and restoration on publicly owned lands, especially in Suisun Marsh and the Yolo Bypass, would be emphasized. There would be more stressor management actions (e.g., programs for water quality, water flows) and more management for nonnative invasive species. Water quality improvements would be the same as for the Proposed Project. Actions under Alternative 3 to reduce flood risk would not include setback levees or subsidence reversal but would result in greater levee modification and maintenance and dredging relative to the Proposed Project. Reservoir reoperation and rock stockpiling would be the same as for the Proposed Project, as would activities to protect and enhance the Delta as an evolving place.

5.4.8.1.1 Impact 5-1: Substantially Alter the Existing Drainage Pattern of the Site or Area, Including Through the Alteration of the Course of a Stream or River, or Substantially Increase the Rate or Amount of Surface Runoff in a Manner Which Would Result in Flooding On- or Offsite

The same types of impacts related to drainage pattern alteration from construction and operation of water supply reliability facilities would occur under Alternative 3 as described under the Proposed Project in areas located outside of the Delta. However, alteration of drainage patterns and runoff due to groundwater projects, ocean desalination projects, recycled wastewater and stormwater projects, water transfers, and water use efficiency would be less likely under Alternative 3 than the Proposed Project because of fewer projects or actions because many of the policies in the Proposed Project would not apply to water users located in the Delta under Alternative 3.

Projects and actions to improve water quality would be the same as under the Proposed Project. Construction-related impacts associated with alteration of drainage patterns and surface runoff during ecosystem restoration could be less with Alternative 3 than with the Proposed Project because restoration activities would be less extensive. Flood risk reduction projects, including construction of levees in the Delta, may be less likely under Alternative 3 because flood risk management would emphasize modification of existing levees and dredging, while floodplain expansion and protection would be less likely than under the Proposed Project.

Overall, significant impacts related to alteration of drainage patterns and surface runoff under Alternative 3 would be **less than** under the Proposed Project.

As compared to existing conditions, the impacts related to alteration of drainage patterns and surface runoff under Alternative 3 would be **significant**.

5.4.8.1.2 Impact 5-2: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Impacts on existing or planned stormwater drainage systems and the likelihood of contributing additional sources of polluted runoff would be reduced relative to the Proposed Project under Alternative 3 for the reasons described in Section 5.4.8.1.1. The overall extent of impacts to existing drainage systems would likely be less than for the Proposed Project because fewer total projects would be constructed, depending on the specific hydrologic and hydraulic factors of levee improvement actions and activities.

Overall, significant impacts on existing or planned stormwater drainage systems under Alternative 3 would be **less than** under the Proposed Project.

As compared to existing conditions, the impacts on existing or planned stormwater drainage systems under Alternative 3 would be **significant**.

5.4.8.1.3 Impact 5-3: Place Housing Within a 100-year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map

Projects encouraged by Alternative 3 would not include placement of new housing within a 100-year flood hazard area. Thus, there would be **no impact**.

5.4.8.1.4 Impact 5-4: Expose People or Structures to a Significant Risk of Loss, Injury or Death Involving Flooding, Including Flooding as a Result of the Failure of a Levee or Dam

Under Alternative 3, water supply reliability projects and actions under Alternative 3 would be similar to those of the Proposed Project, although there would less emphasis on projects for water users located within the Delta. This would likely reduce to potential for impacts caused by flooding as a result of levee failure associated with construction of water and wastewater facilities along Delta levees.

Flood risk reduction projects, including construction of levees in the Delta, may be less likely under Alternative 3 because flood risk management would emphasize modification of existing levees and dredging, while floodplain expansion and protection would be less likely than under the Proposed Project. Flood management impacts associated with alteration of drainage patterns and surface runoff in the Delta would be less likely than under the Proposed Project. It is unclear whether these actions would increase or decrease the overall risk of flooding as a result of dam or levee failure.

Overall, significant impacts associated with flooding as a result of levee or dam failure under Alternative 3 would be the **same as** the Proposed Project.

As compared to existing conditions, the impacts associated with flooding as a result of levee or dam failure under Alternative 3 would be **significant**.

5.4.8.1.5 Impact 5-5: Place Within a 100-year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Inundation by Seiche, Tsunami, or Mudflow

Under Alternative 3, water supply reliability projects and actions under Alternative 3 would be similar to those of the Proposed Project.

Flood risk reduction projects, including construction of levees in the Delta, may be less likely under Alternative 3 because flood risk management would emphasize modification of existing levees and dredging, while floodplain expansion and protection would be less likely than under the Proposed Project. Flood management impacts associated with alteration of drainage patterns and surface runoff would be less likely than under the Proposed Project. This would likely decrease the likelihood that new levees would impede or redirect flood flows or expose structures to inundation by seiche, tsunami, or mudflow.

Overall, significant impacts associated with placement of structures within a 100-year flood hazard area under Alternative 3 would be **less than** under the Proposed Project.

As compared to existing conditions, the impacts associated with placement of structures within a 100-year flood hazard area under Alternative 3 would be **significant**.

5.4.8.2 Mitigation Measures

Mitigation measures for impacts associated with Alternative 3 would be the same as those described for the Proposed Project in Sections 5.4.3.6.1 (Mitigation Measure 5-1), 5.4.3.6.2 (Mitigation Measure 5-2), 5.4.3.6.3 (Mitigation Measure 5-4), and 5.4.3.6.4 (Mitigation Measure 5-5). Because it is not known whether the mitigation measures listed above would reduce impacts to a less-than-significant level for Alternative 3, these potential impacts are considered **significant and unavoidable**.

5.5 References

Baldwin. 2010. San Joaquin County Office of Emergency Services Responses to Delta Stewardship Council Questions (Memo to DPC dated 4/27/10). May.

Cal EMA. 2009. State of California Emergency Plan. Sacramento. July.

Cal EMA. 2010a. Foundation for the Standardized Emergency Management System SEMS. State of California, California Emergency Management Agency. Sacramento. January.

Cal EMA. 2010b. Sacramento-San Joaquin Delta Multi-Agency Coordination System (MACS), Operations Guide. 4th Draft. October.

Cal EMA. 2011. Vision and Mission. Accessed October 2011. http://www.calema.ca.gov/NewsandMedia/Pages/Vision-and-Mission.aspx.

CALFED (CALFED Bay-Delta Program). 2000. *Seismic Vulnerability of the Sacramento–San Joaquin Delta Levees*. R. A. Torres et al.

CCP (Center for Collaborative Policy). 2008. A Strategy for Collaborative Emergency Response Planning in California’s Delta Region, Phase I Report, Prepared for Delta Protection Commission and Governor’s Office of Emergency Services. Prepared by California State University, Sacramento, Center for Collaborative Policy. June.

City of Carlsbad. 2005. *Carlsbad Precise Development Plan and Desalination Plant Project Environmental Impact Report*. Carlsbad, CA.

City of Davis. 2007. *Davis-Woodland Water Supply Project Draft Environmental Impact Report*. Davis, CA. In association with UC Davis and City of Woodland. April.

City of Huntington Beach. 2005. *Draft Recirculated Environmental Impact Report #2001051092 Seawater Desalination Project at Huntington Beach*. April 2005.

Dutra, Edward. 1980. *History of Sidedraft Clamshell Dredging in California*. 2nd Edition Dutra Dredging Company. 1980.

DWR (California Department of Water Resources). 1980. Seismicity Hazards in the Sacramento-San Joaquin Delta. State of California, the Resources Agency, Department of Water Resources, Central District. October.

DWR (California Department of Water Resources). 1982. *Delta Levees Investigation, Bulletin 192-82*.

DWR (California Department of Water Resources). 1992. Seismic Stability of Delta Levees.

DWR (California Department of Water Resources). 1993. *Southern Delta Scour Monitoring: 1991 and 1992*. Sacramento, California.

DWR (California Department of Water Resources). 1995. *Sacramento San Joaquin Delta Atlas*. Reprinted July 1995. Sacramento, California.

DWR (California Department of Water Resources). 2000. *Suisun Marsh Monitoring Program, Reference Guide, Version 2*. June.

DWR (California Department of Water Resources). 2007. *Delta Emergency Operations Plan Concept Paper*. Sacramento. April. Accessed October 2010: http://www.water.ca.gov/floodmgmt/docs/Delta_EOP_Concept_Paper-March_2007.pdf

DWR (California Department of Water Resources). 2008a. *Draft FloodSAFE Strategic Plan*. Draft May 28.

DWR (California Department of Water Resources). 2008b. *Levee Failures in Sacramento–San Joaquin River Delta*. Site accessed January 19, 2008. URL = http://www.water.ca.gov/floodmgmt/docs/DeltaLeveeFailures_FMA_200709.pdf.

DWR (California Department of Water Resources). 2008c. *State Plan of Flood Control Initial Status Report*.

DWR (California Department of Water Resources). 2008d. Delta Risk Management Strategy (DRMS) Phase 1, Risk Analysis Report, Final. Prepared by: URS Corporation/Jack R. Benjamin & Associates, Inc. Prepared for DWR, USACE, and DFG. December. Available at http://www.water.ca.gov/floodmgmt/dsmo/sab/drmsp/phase1_information.cfm.

DWR (California Department of Water Resources). 2008e. California Levee Database. Accessed February 23, 2011. Available at http://www.water.ca.gov/floodmgmt/lrafmo/fmb/fes/levee_database.cfm.

DWR (Department of Water Resources). 2009. Locations and attributes of levees in California as maintained by the DWR California Levee Database. December.

DWR (California Department of Water Resources). 2010a. Best Available Maps. http://www.water.ca.gov/floodmgmt/lrafmo/fmb/fes/ best_available_maps/

DWR (California Department of Water Resources). 2010b. Best Available Map, San Joaquin County, sjn_b1. http://www.water.ca.gov/floodmgmt/lrafmo/fmb/fes/best_available_maps/san_joaquin/sjn_b1.pdf.

DWR (California Department of Water Resources). 2010c. Levee Protected Flood Zones, Sacramento River Basin. http://www.water.ca.gov/floodmgmt/lrafmo/fmb/docs/SacramentoRiver_LFPZ_Map.pdf.

DWR (California Department of Water Resources). 2010d. Levee Protected Flood Zones, San Joaquin River Basin. http://www.water.ca.gov/floodmgmt/lrafmo/fmb/docs/SanJoaquinRiver_LFPZ_Map.pdf.

DWR (California Department of Water Resources). 2010e. *Final Environmental Impact Report: North Delta Flood Control and Ecosystem Restoration Project*. Sacramento, CA. October.

DWR (California Department of Water Resources). 2011a. Delta Risk Management Strategy, Phase 2 Report. Prepared by: URS Corporation/Jack R. Benjamin & Associates, Inc. June 2011. Available at http://www.water.ca.gov/floodmgmt/dsmo/sab/drmsp/phase2_information.cfm#.

DWR (California Department of Water Resources). 2011b. Delta Flood Emergency Preparedness, Response, and Recovery Program: An Overview. FloodSAFE California. June.

DWR and DFG (California Department of Water Resources and California Department of Fish and Game). 2008. A Report Pursuant to Requirements of Assembly Bill 1200, Laird, Risks and Options to Reduce Risks to Fishery and Water Supply Uses of the Sacramento/San Joaquin Delta. January 2008.

FEMA (Federal Emergency Management Agency). 2005. Technical Manual for Dam Owners, Impacts of Animals on Earthen Dams, FEMA 473.

FEMA. 2010a. FEMA: Map Modernization. Website accessed October 20, 2011. http://www.fema.gov/plan/prevent/fhm/mm_main.shtm.

FEMA. 2010b. FEMA Flood Hazard floodplain mapping for the state of California. Available at: http://www.msc.fema.gov/webapp/wcs/stores/servlet/FemaWelcomeView?storeId=10001&catalogId=10001&langId=-1.

FEMA. 2010c. Impact of Climate Change on the NFIP. Coastal Engineering Research Board Meeting. June 22.

Johnson, M., and L. Pellerin. 2010. *What's in Your Levee*. Geo-Strata. March/April 2010.

Kelley, R. 1998. *Battling the Inland Sea Floods, Public Policy, and the Sacramento Valley, 1850–1986*. University of California–Berkeley.

Little Hoover Commission. 2006. *Safeguarding the Golden State: Preparing for Catastrophic Events*, the Little Hoover Commission. Accessed October 30, 2011. http://www.lhc.ca.gov/studies/184/report184.html.

PPIC (Public Policy Institute of California). 2007. *Envisioning Futures for the Sacramento–San Joaquin Delta*. J. Lund, E. Hanak, W. Fleenor, R. Howit, J. Mount, and P. Moyle.

PPIC (Public Policy Institute of California). 2008a. *Navigating the Delta, Comparing Futures for the Sacramento–San Joaquin Delta*. W. Bennet, W. Fleenor, E. Hanak, R. Howitt, J. Lund, J. Mount, and P. Moyle. 2008.

PPIC (Public Policy Institute of California). 2008b. *Levee Decisions and Sustainability for the Delta, Technical Appendix B*. R. Suddeth, J. Mount, and J. Lund. 2008b.

Reclamation, (U.S. Bureau of Reclamation), Contra Costa Water District, and Western Area Power Administration. 2009. *Los Vaqueros Reservoir Expansion Project Draft Environmental Impact Statement/Environmental Impact Report*. February.

Reclamation, USFWS, and DFG (U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, and California Department of Fish and Game). 2010. Suisun Marsh Habitat Management, Preservation, and Restoration Plan. *Draft Environmental Impact Report/Environmental Impact Statement.* October.

San Diego County Department of Parks and Recreation. 2008. *Draft Programmatic Environmental Impact Report: San Luis Rey River Park Master Plan*. San Diego, CA. February.

San Joaquin County OES (Office of Emergency Services). 1995. San Joaquin County Flood Evacuation Plan. Revised June 1995. Accessed October 2011. http://www.sjgov.org/oes/getplan/Delta_Flood_plan.pdf.

San Joaquin County OES (Office of Emergency Services). 2010a. Contingency Map for Bacon Island. Accessed October 2010. http://www.sjmap.org/oesfcm/BaconIsland_Quad.pdf.

San Joaquin County OES (Office of Emergency Services). 2010b. Joint Flood Fight Commands. Accessed October 2010. http://www.sjmap.org/oesfcm/UnitedFloodFightCommands.pdf.

San Joaquin County OES (Office of Emergency Services). 2011. OES Flood Contingency Mapping. San Joaquin County Geographic Information Systems. Accessed October 2011. http://www.sjmap.org/oesfcm/.

Senate Bill 27. 2008. Sacramento-San Joaquin Delta Emergency Preparedness Act of 2008. http://www.leginfo.ca.gov/pub/07-08/bill/sen/sb_0001-0050/sb_27_bill_20080930_chaptered.pdf.

Senate Bill 1443. 2010. Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force. http://www.leginfo.ca.gov/pub/09-10/bill/sen/sb_1401-1450/sb_1443_bill_20100924_chaptered.pdf.

SFPUC (San Francisco Public Utilities Commission). 2011. *Final Environmental Impact Report: Calaveras Dam Replacement Project*. San Francisco, CA. January.

The Nature Conservancy and DPR (California Department of Parks and Recreation). 2008. *Final Environmental Impact Report: Bidwell–Sacramento River State Park Habitat Restoration and Outdoor Recreation Facilities Development Project*. Chico, CA. Prepared by EDAW/AECOM, Sacramento, CA. September 17.

Thompson, John. 1982. Discovering and Rediscovering the Fragility of Levees and Land in the Sacramento-San Joaquin Delta, 1870 – 1879 and Today. Published by DWR, Central District. March.

USACE (U.S. Army Corps of Engineers). 1982. Sacramento-San Joaquin Delta California Documentation Report. October 1982.

USACE (U.S. Army Corps of Engineers). 1992. Yolo Basin Wetlands, Sacramento River, California, Project Modification Report (Section 1135)," April 1992.

USACE (U.S. Army Corps of Engineers). 1999. *Sacramento and San Joaquin River Basins, California. Post-Flood Assessment*. U.S. Army Corps of Engineers, Sacramento District. March 29.

USACE (U.S. Army Corps of Engineers). 2000. *Design and Construction of Levees*. Manual No. 1110-2-1913. Washington, D.C. April 30.

USACE (U.S. Army Corps of Engineers). 2001. *Emergency Employment of Army and Other Resources - Civil Emergency Management Program*. Engineering Regulation 500-1-1 (ER 500-1-1). Washington, D.C. September 30.

USACE (U.S. Army Corps of Engineers). 2002a. *Comprehensive Study, Sacramento and San Joaquin River Basins*. Sacramento, California.

USACE (U.S. Army Corps of Engineers), Sacramento District. 2008a. “Geotechnical Levee Practice,” Reference Report REFPIOLO.doc, effective 04/11/2008.

USACE (U.S. Army Corps of Engineers). 2008b. Lower San Joaquin River Feasibility Study Project Management Plan.

USACE (U.S. Army Corps of Engineers). 2009. Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures. Technical Letter No. 1110-2-571 (ETL 1110-2-571). Washington, DC. April.

USACE (U.S. Army Corps of Engineers) and the Port of West Sacramento. 2011. *Draft Supplemental Environmental Impact Statement/Subsequent Environmental Impact Report: Sacramento River Deep Water Ship Channel*. February. West Sacramento, CA. Site accessed March 8, 2011. http://www.spn.usace.army.mil/projects/dwsc/eis_seis/_SRDWSC_Draft_SEIS-SEIR.pdf.

U.S. Department of Homeland Security. 2009. Security Awareness for Levee Owners. Site accessed April 22, 2010. http://www.damsafety.org/media/Documents/Security/SecurityAwarenessforLeveeOwners.pdf.

USGS (U.S. Geological Survey). 2010. GIS data for the National Hydrography Dataset for CA “NHD11005_CA.gdb”. March. Accessed June 1, 2010. Available at ftp://nhdftp.usgs.gov/StateExtracts/High/FileGDB/.